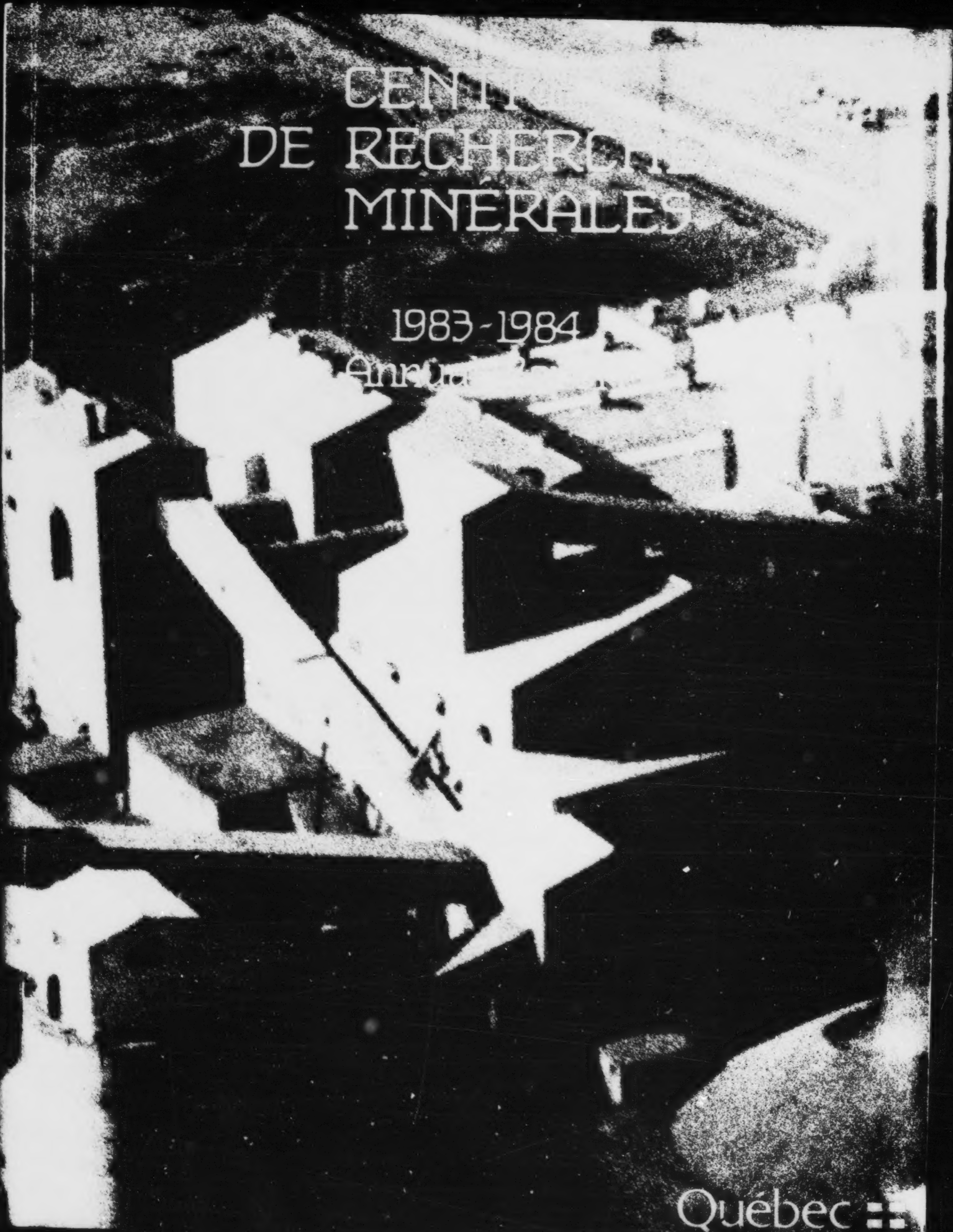

CENTRE DE RECHERCHES MINÉRALES

1983-1984
Annual Report

Québec

85-4372/

CENTRE
DE RECHERCHES
MINÉRALES

1983-1984
Annual Report

Québec

AN OVERVIEW OF CRM

The Centre de Recherches Minerales (CRM) has the status of a General Directorate within the Mines Branch of The Québec Ministry of Energy and Resources (MER) (Ministère de l'Energie et des Ressources du Québec) . As an applied research organization, the center provides scientific and technical support to the mining and metallurgical industry, and promotes the growth and economic development of this field. Services offered by CRM to the industrial sector are part of a much wider range of services provided by MER to promote industrial development in Québec.

CRM offers a wide range of services and undertakes research work in mineral analysis, mineralogy, and extractive metallurgy, at both the laboratory and pilot plant scales, as well as in mining technology.

The mandate of CRM is:

- to promote the production, processing, transformation and exploitation of Québec's mineral reserves;

- to enhance the research activities of the mining industry;

- to participate in mineral resource management, and to contribute to the application of a mineral policy adapted to the specific needs of Québec.

Further information may be obtained by calling the Marketing and Control office, at (418) 643-4540.

A MESSAGE FROM THE DIRECTOR GENERAL

The year 1983-84 marks the start of "1983-86 Development Plan" at the Centre de Recherches Minerales (CRM), entitled "The Role of the Ministry of Energy and Resources (MER) in Mineral Research" (Role du Ministère de l'Energie et des Ressources en Recherche Minerales) . This extensive presentation of thoughts and trends has been well received by both government officials and the Québec mining industry in general. As a result of the plan, CRM received a total of $472,000 from the Ministry of Science and Technology during 1983-84. This funding enabled CRM to accelerate the application of its "get it done" policy towards universities and regional participants, and to move ahead in the development of a large installation leading to the possibility of performing autogenous and semi-autogenous grinding studies at its pilot plant.

In 1983-84, CRM completed a metamorphosis, in a sense, in its research activities, becoming an organization dedicated almost exclusively to industrial services. This change was made possible, among other things, by the launching of a Marketing Division, and by a substantial reduction of its internal projects in favour of applied research activities directed towards industrial research needs. The overall revenues of CRM grew 68%, compared to the previous year.

In order to renew and enrich its awareness of industrial priorities in mineral research, and to advertise the scope of available services, CRM organized a number of noteworthy seminars in 1983-84. These activities were further prompted by a desire to encourage dialogue among the various participants. No doubt the most important event of the year was the seminar on Gold Ore Processing, held in Val d'Or in March 1984. This two-day event presented gold producers with a forum to discuss major problems encountered in the valorisation process, and brought to light the fact that it may be worthwhile for this sector of the industry to devote more of its efforts to applied research. Two other seminars and a round-table discussion were organized in Québec City, with interested industrial representatives, to discuss productivity in open-pit mines, ground control in underground mines, and research needs related to our niobium ores.

In 1983-84 the renovation of the CRM pilot plant continued, and is over 85% completed. During the year, this work required the expenditure of about one million two hundred and fifty thousand dollars ($1,250,000). The building itself had the roof redone, the insulation of exterior walls was completed with the addition of an asbestos-cement facing material, and several laboratories were refurbished, as were a number of offices and storage areas. In the experimental halls, the renovation work paved the way for some major improvements to the experimental equipment used in hydrometallurgy and pyrometallurgy, particularly to support the priority research programs in the iron and gold sectors.

The Analysis and Control (A/C) group at CRM made a record number of determinations and studies during 1983-84; the overall count of 777,164 is nearly a 100% increase over the previous year's total. This increase was made possible, despite a staff cutback, through tighter management and thanks to the acquisition of new high-performance analytical equipment. On the other hand, a growing demand from MER geologists has increasingly led CRM to call upon private laboratories to undertake a certain part of the analyses; in 1983-84, contracts valued at more than $680,000 were awarded to outside laboratories. Analytical research, an essential activity for an analytical laboratory, has once again this year further improved the quality of services rendered to customers, by providing faster results in certain cases, and in others, improved precision in the supplied results. To maintain and even increase its productivity in the coming years, the Analysis and Control section completed the installation of a second plasma atomic emission spectrometer, and has acquired an automated X-ray fluorescence spectrometer. A new system of computerized data-management was developed during the year, and finally put into operation in March 1984. While directly improving customer services, this system is also used to manage day-to-day laboratory activities.

The Research and Development (R/D) section at CRM, working on mineral beneficiation and extractive metallurgy, was involved in 114 projects during 1983-84, of which 61 were funded by private companies within the Québec mineral industry.

Following a gradual economic recovery, and a resurgence of confidence in the future of the mineral industry throughout the year, the R/D group experienced a very active second-half, leading to an all-time high in the number of industrially-funded projects. The considerable increase in gross revenues has clearly been influenced by a more agressive marketing of services.

Consistent with the 1983-86 Development Plan, the main areas of activity in the R/D group in 1983-84 have been those of the industrial minerals, iron, gold, and niobium. No doubt the most impressive project involving industrial minerals was the one leading to the development of a process to recover most of the diamonds used in granite-cutting operations by a large Québec company. In the area of precious metals, the year was marked by a considerable increase in activities. For example, following laboratory testwork, these efforts established the amenability of reprocessing mine tailings, such as those of the old Montauban mine, to extract gold and silver. This will most likely culminate in an industrial project. The demonstrated expertise of CRM in the area of gold precipitates refining and the optimization of fusion practices, has attracted interest from many of the gold producers in the northwest. In the iron ore sector, CRM is now being recognized more and more as the Canadian 'center of excellence' in this area. Numerous initiatives taken by CRM in recent years to complete its instrumentation and upgrade its expertise in this area have evidently borne fruit. During the 1983-84 year, CRM has undertaken several projects in collaboration with iron ore producers to improve plant productivity and, more recently, to indirectly sustain the marketing of their products. In the fall of 1983, CRM participated in an extensive industrial-scale experimental program to demonstrate the feasibility of pelletizing iron ore with peat; this process has been developed by CRM over the past few years. The niobium area has once again, in 1983-84, captured a good part of the resources of the R/D group at CRM. Researchers have conducted extensive testwork, both in the laboratory and at the pilot plant, on ore from the Crevier deposit. In order to increase its effective participation, CRM granted a number of research contracts to universities and local industries during 1983-84. This policy is proving to be more and more useful in bringing together, at reasonable cost, the various organizations involved in mining research, much to benefit of Québec's mineral industry. In 1983-84, Dr. Gilles Barbery, of the Mining Engineering Department at Laval University, was elected to the post of president of the CRM advisory committee. This committee, formed in 1980, continues to contribute significantly to the success of the center.

The Mining Technology Section (STM) of CRM will remember 1983-84 as its first complete year of activity. This new section of CRM took over its offices at the Complexe Scientifique in the fall of 1983. Its soil mechanics laboratory was completed and several acquisitions saw the rock mechanics laboratory taking shape as well. Although the section is still young, it was nonetheless involved in several research projects, carried out for mining companies in the northwest. The section was particularly active in applied rock mechanics, energy conservation, and underground communications. Near the end of 1983-84, a large-scale contract was signed with Québec Metal Mining Association (l'Association des Mines de Metaux du Québec), to allow STM to provide most underground mines in Québec with badly needed technical studies relative to mining equipment. In order to assure, from the beginning, that STM was pursuing appropriate goals, the section was provided with an advisory committee, made up of representatives from industry, university, and government. The presence of this committee has fulfilled all expectations.

In conclusion, it gives me great pleasure to acknowledge the contribution of the staff of CRM, responsible for the many successes throughout the 1983-84 year. On behalf of the clients we serve, I would like to express my sincere thanks to all of them.

The Director-General

Marc Denis Everell, Eng.
Centre de Recherches minerales
Sainte-Foy, June 13, 1984.

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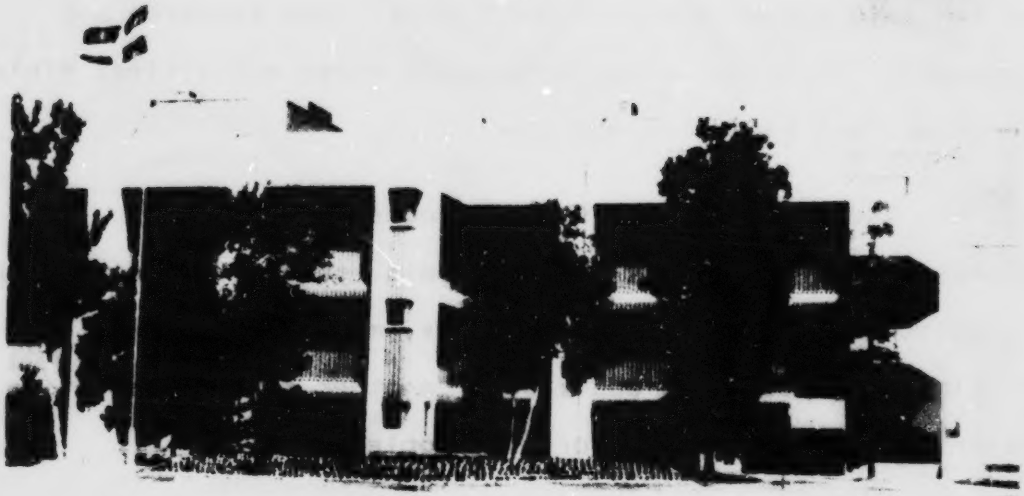
INTRODUCTION

One way to become familiar with an organization is to study its objectives, makeup, personnel, and field of activities: in short, to explore its accomplishments. The purpose of this publication is to present CRM through its accomplishments, and to shed light on the variety and extent of its activities.

As an overall picture of the organization, CRM is one of three General Directorates within the Mines Branch of the Québec Ministry of Energy and Resources (MER)(Ministère de l'Energie et des Ressources du Québec) and its activities fall into two main areas: Analysis and Control, and Research and Development. Two other areas complement these activities: Mining Technology, and Marketing and Control.

The permanent staff of CRM consists of nine administrators, thirty-six professionals, seventy technicians and specialists, and twenty office workers, making a total of 135 full-time employees. The addition of another fifteen part-time workers makes a grand total of 150 people.

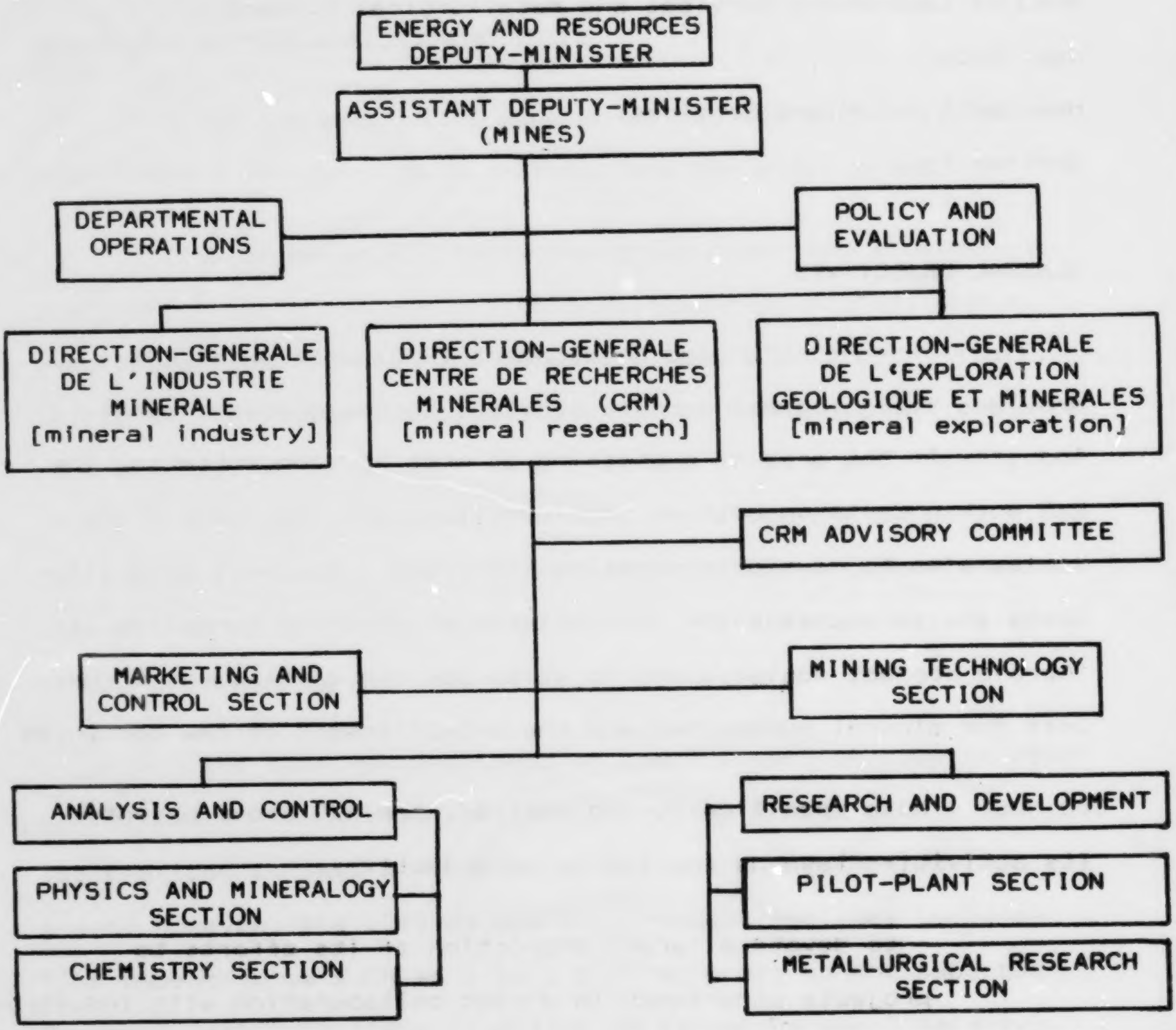
The CRM laboratories occupy part of the Complexe Scientifique, located at 2700 rue Einstein, Sainte-Foy, Québec, and the pilot plant is located in the St-Malo Industrial Park, at 1180 Place Dufresne in Québec City. The organization chart in Table 1 shows the position of CRM within the Mines Branch, and the various sections within CRM.



CRM is located at 2700 rue Einstein, Sainte-Foy, Québec

TABLE 1

DEPARTMENT OF ENERGY AND RESOURCES, MINES BRANCH


ENERGY AND RESOURCES DEPUTY-MINISTER
ASSISTANT DEPUTY-MINISTER (MINES)
DEPARTMENTAL OPERATIONS
POLICY AND EVALUATION
DIRECTION-GENERALE DE L'INDUSTRIE MINERALE [mineral industry]
DIRECTION-GENERALE CENTRE DE RECHERCHES MINERALES (CRM) [mineral research]
DIRECTION-GENERALE DE L'EXPLORATION GEOLOGIQUE ET MINERALES [mineral exploration]
CRM ADVISORY COMMITTEE
MARKETING AND CONTROL SECTION
MINING TECHNOLOGY SECTION
ANALYSIS AND CONTROL
PHYSICS AND MINERALOGY SECTION
CHEMISTRY SECTION
RESEARCH AND DEVELOPMENT
PILOT-PLANT SECTION
METALLURGICAL RESEARCH SECTION

RESEARCH AND DEVELOPMENT

Director:

Alain Claveau

Head of Laboratory Services and Metallurgical Research:

Jean Gobeil

Head of Pilot-Plant Services:

Gontran Foy

GENERAL OBJECTIVES

The Research and Development (R/D) section at CRM provides technological support services to the Québec mineral industry in the area of processing of ores and concentrates. The R/D work undertaken both at the laboratory and the pilot plant scales aims to develop processing techniques, to lower production costs and to increase the productivity of existing companies, to improve product quality, and to stimulate the development of new uses for mineral substances and the establishment of new companies.

More specifically, in 1983-84, the R/D group oriented its activities towards the following objectives:

- to devote a larger proportion of its efforts to projects undertaken in direct collaboration with industry;
- to increase its activities in the area of processing iron ore and precious metal ores in order to encourage these two major sectors of the Québec mineral industry.

The CRM advisory committee, with its ten members representing a variety of disciplines within the mineral industry, met twice during the year, and its suggestions and recommendations closely support the above objectives.

ORGANIZATION/PERSONNEL/EXPENDITURES

The R/D section is made up of two sub-sections: the metallurgical research laboratories, and the pilot plant.

As of March 31, 1984, the group comprised a permanent staff of sixty: three administrators, seventeen professionals, twenty-two technicians, nine labourers, and nine support-staff. Thirty-two full-time employees work at the metallurgical research laboratories, while another 26 are at the pilot plant. During the course of the year, two professionals and a technician were hired for three-year terms, and the equivalent of three person-years were filled by part-time employees. The staff directly involved in R/D projects during 1983-84 totalled 46 person-years.

The total expenditures of the R/D section rose in 1983-84 to almost five million dollars, of which approximately $300,000 was provided through a Ministry of Science and Technology grant. However, the 1983-84 operating budget includes two one-time expenditures such as a $1.1 million grant to the Asbestos Research Institute (IRDA)(Institut de Recherche sur l'Amiante), and start-up expenses of over $1.3 million associated with pilot-plant renovations. Consequently, the amount actually spent on projects for the mineral industry was $2.6 million in 1983-84, divided into $1.1 million for the pilot plant, and $1.5 million for the laboratories.

SUMMARY OF ACTIVITIES

The personnel of the R/D section contributed to 114 projects in 1983-84, of which 61 were funded by companies within the Québec mineral industry. The 1983-84 year was marked by two distinct but vastly different periods. During the first half of the year, (March-September, 1983) very few projects were undertaken by the mineral industry, and most of the activities of the group were directed towards internal projects, pilot studies, or projects in collaboration with, but not funded by, the industry. This situation was largely due to extremely poor 1982 economic conditions which continued well into 1983. However, the situation changed dramatically during the second half of the year (October 1983 - March 1984), and a large number of projects were proposed and funded by several mineral industries, both in the laboratory and at the pilot plant. This welcome development, while satisfying our objectives, was due in part to an upswing in economic conditions, but is especially a reflection of some serious efforts in the marketing of our services, and in the establishment of closer contacts with the mineral industry during the past year.

Overall, the 1983-84 results are satisfying, especially if the second-half performance continues unabated through 1984-85, as expected. Our objective of orienting a greater part of our resources towards the immediate needs of the industry was to a large extent realized, since 89 of the year's 114 projects were undertaken in direct or indirect collaboration with the industry (Table 2). The individual value of projects undertaken was considerably higher in 1983-84 (Table 3), more than 60% of the projects ranged between $5,000 and $50,000, compared to only 36% the previous year. In all, 94 project proposals were made to the mineral industry during the year, of which 63 were accepted (67%). These projects, mostly completed in 1983-84, represent a value of more than $1.6 million.

Several noteworthy projects were undertaken in 1983-84 for companies in the mineral sector, of which the most interesting are highlighted in the following examples:

- an inexpensive process was developed for recovering more than 50% of the diamonds used at a major Québec granite-cutting plant;

- pelletizing technology was applied, with promising results, to the agglomeration of asbestos dust and salt fines;

- beneficiation testwork was conducted on eight (8) gold deposits, of which several have an excellent chance of viability;

- heap-leaching experiments to recover precious metals from abandoned mine tailings in the Québec region (03), gave excellent results and may soon lead to industrial application;

TABLE 2

Nature of R/D Projects

SECTION	EXTERNALLY-SUPPORTED		PILOT-STUDIES & JOINT PROJECTS		INTERNAL PROJECTS	
	Number	Value $'000	Number	Value $'000	Number	Value $'000
Laboratory	46	672.6	25	162.0	21	462.8
Pilot-Plant	15	580.8	3	95.6	4	182.1
TOTAL	61	1,253.4	28	257.6	25	644.9

TABLE 3

Value of R/D Projects, 1983-84

VALUE OF PROJECTS ($)	NUMBER OF PROJECTS
over 100,000	2
50,000 - 100,000	4
20,000 - 50,000	20
5,000 - 20,000	49
1,000 - 5,000	32
under 1,000	7

- laboratory tests have improved knowledge of the mechanisms controlling the reducibility of pellets produced by a Cote-Nord (09)(North-Shore) iron producer;

- a laboratory study has led to the development of a process to clarify the red-coloured effluent water of another iron producer and is a promising candidate for industrial application;

- efforts have continued towards the development of a beneficiation process for the Crevier niobium-tantalum deposit; laboratory experiments have identified a promising flotation method but testwork at the pilot scale has as yet failed to completely confirm the results.

The internal projects, completed during the year, are also highlighted by the following examples:

- the development of the carbon-in-pulp technique, a method of extracting gold from leaching solutions, was undertaken through bench-scale testwork;

- the pot-grate test equipment at the pilot plant has been completed and modifications have been made, permitting its use with iron ore sinters;

- a standard apparatus for measuring the reductibility of iron ore pellets was installed during the year and will allow testwork to be performed in order to improve this important property of pellets produced in Québec-Labrador;

- the pilot plant autogeneous mill has been installed and equipped with a variety of peripheral instrumentation, making it a highly developed research apparatus, allowing an in-depth study of this technique of grinding which is widely used in Québec.

A large part of the renovation work at the pilot plant was completed during the year, at a cost of over $1.2 million, including $200,000 from a grant by the Québec Ministry of Science and Technology. The roof, the exterior walls, the windows, and the insulation were all redone. Substantial interior renovations were also completed. The offices, rest-areas, cloakrooms, and stores were all rebuilt. The autogeneous mill was installed, the hydro-metallurgical section was improved, and a gas exhaust and dust control system was added to all the pyro-metallurgical installations. Next year, reorganization of the laboratories and improvements to the ventilation and lighting will complete this project, which has involved the investment of over $2.1 million.

In addition to internal research work, $164,000 in contracts were awarded to university groups and outside organizations, (Table 4). Some of the funding necessary to the allocation of these contracts came from the Ministry of Science and Technology. Numerous research projects were undertaken externally and include;

a) The optimization, instrumentation, and control of metallurgical processes.

b) A study of the potential of electrometallurgical processing of Québec chalcopyrites.

c) Studies on the pelletizing and sintering of Québec iron ore.

d) A study of column flotation as a way to recover pyrochlore slimes, and finally

e) A study into the potentials of heap-leaching in processing the gold ores of northwestern Québec.

These contracts enabled us to offer improved service to the Québec mineral industry, by directing basic research into the hands of specialized groups who complement the expertise of our staff with theirs.

TABLE 4

Research Contracts Awarded to External Organizations

TITLE	EXTERNAL ORGANIZATION	VALUE ($)
Optimization of Mineralogical Processes	GRAAIM Laval University	18,100
Analysis, Instrumentation and Control of Mineralogical Processes	GRAAIM Laval University	58,000
Electrometallurgy of Québec Auriferous Chalcopyrites	Laval University	11,300
Valorization of Iron Oxides by a Pelletizing Process	Ecole Polytechnique	7,500
Physico-chemical Characterization of Iron Ores and their Behavior as Agglomerates	Ecole Polytechnique	15,800
Recovery of Pyrochlore Slimes by Column Flotation.	McGill University	10,700
The Possible Use of Heap-Leaching to treat gold ores from Québec's Northwest	Laboratoire-Mineralogique 110750 Canada Ltd. Val d'Or, Québec	43,200
		164,600

Table 5 summarizes the different types of activities undertaken by the R/D personnel during the 1983-84 year. Internal and external activities were shared in the ratio of 47.3% / 52.7% about the same as last year. Resources used on projects in partnership with industry accounted for 58.7% of the resources available for projects. Technical reports totalled 114, and 2 publications appeared in specialized journals. Finally, eight presentations were made by our scientists at conferences, congresses and technical seminars.

A seminar on gold ore processing was organized at Val d'Or, March 15-16, 1983, and brought together more than fifty people directly involved in this area. More than half of this group were superintendents and metallurgists at concentrators in the neighbouring region. This well-received meeting focussed attention on present day concentrator technology, and served as a media of exchange of opinions among the northwest's industrial specialists, as well as those of CRM, and university scientists.

The R/D section also participated with the Department of Mining and Metallurgy of Laval University in organizing a workshop to demonstrate and distribute software developed by CANMET's SPOC group. This five-day meeting attracted fifteen engineers from different Canadian industries to Québec City in October 1983. The great interest in this event led to a number of applications being refused, as technical considerations limited participation to 15 people.

TABLE 5

Activities of the R/D Personnel in 1983-84

NUMBER OF HOURS AVAILABLE : 69,795 hours or 46 person-years

Distribution of Available Hours by Activity	(%)
External Activities:	52.7
Externally Funded Projects	37.1
Pilot-Studies and Joint Projects	7.2
Meetings with Customers and Preparation of Work Programs	4.6
Industrial Visits, Symposiums, Conferences	2.0
External Collaboration	1.8
Internal Activities:	47.3
Internal and Special Projects	16.9
General Research and Technical Documentation	10.5
Administration and Improvements	7.9
Maintenance and Experimental Apparatus	11.9
Distribution of Hours by Area of Activity	(%)
- industrial minerals	16.2
- precious metal and base metal ores	16.3
- iron ores and associated elements	13.9
- niobium ores and associated elements	37.5
- others	16.1

R/D PROJECTS BY AREA OF ACTIVITY

Projects undertaken by the R/D section in 1983-84 may be divided into five sectors as follows;

- industrial minerals
- precious metal and base metal ores
- iron ore and associated elements
- niobium ore and associated elements
- various projects

Table 6 summarizes the activities in each sector, presenting the number of projects by type, with the human and financial resources allocated to each project. The activities in each sector cover both concentration and transformation as well as recovery.

Projects in the area of niobium ores figured prominently during the year, largely due to the Crevier's ore evaluation project. In fact 37.5% of the resources fell into this sector, of which over 88% were externally funded.

In comparison, the four other sectors received about equal emphasis, with each sharing between 14-16% of our efforts. Precious metal processing consumed a much larger proportion than last year; the time spent on this sector has more than doubled.

TABLE 6

Division of Projects by Sector of Activity

ACTIVITIES AND SUB-ACTIVITIES	NUMBER OF PROJECTS	RESOURCES	
		HOURS	$'000
INDUSTRIAL MINERALS			
Externally-Funded	25	3890	190.8
Pilot Projects	8	687	36.0
Joint Projects	1	135	7.7
Internal Projects	5	2448	119.6
Sub-Total	39	7160	354.1
PRECIOUS METAL AND BASE METAL ORES			
Externally-Funded	17	4185	218.4
Pilot Projects	5	619	38.1
Joint Projects	2	135	1.3
Internal Projects	4	2358	112.9
Sub-Totals	28	7184	370.4
IRON ORES AND ASSOCIATED ELEMENTS			
Externally-Funded	10	2425	118.3
Pilot Projects	4	806	48.2
Joint Projects	1	238	13.5
Internal Projects	5	2671	125.5
Sub-Totals	20	6140	305.5
NIOBIUM ORES AND ASSOCIATED ELEMENTS			
Externally-Funded	6	14584	684.4
Pilot Projects	2	286	13.8
Joint Projects	1	30	1.7
Internal Projects	5	1681	85.2
Sub-Totals	14	16581	785.1

TABLE 6

Division of Projects by Sector of Activity (Cont')

ACTIVITIES AND SUB-ACTIVITIES	NUMBER OF PROJECTS	RESOURCES	
		HOURS	$'000
OTHERS			
Externally-Funded	3	283	19.3
Standard Determinations	-	566	22.2
Pilot Projects	1	24	1.5
Joint Projects	3	2185	95.8
Internal Projects	6	2391	113.1
General Research	-	1751	88.6
Sub-Totals	13	7128	340.5
OVERALL SECTORS			
Externally-Funded	61 (53.5%)	25933 (58.7%)	1253.4
Pilot Projects and Joint Projects	28 (24.5%)	5023 (11.4%)	257.6
Internal Projects and General Research	25 (22.0%)	13228 (29.9%)	644.9
Contracts	-	-	164.6
Sub-Totals	114	44193	2320.5

In the area of iron ore, much effort went into the definition of priority projects for this industry, and to the acquisition and installation of the equipment necessary to undertake large-scale projects. Activities in this area increased over 30%, and the enthusiastic response of industry promises that this growth will continue through 1984-85.

Tables 7 and 8 show projects broken-down by customers and by regions within Québec. The tables show that close to 78% of funded projects were in collaboration with the larger companies, and that the projects were primarily concerned with deposits or industries in Saguenay-Lac St.Jean (region 02), Abitibi-Temiscaminque (08), and Cote-Nord-Nouveau Québec (09,10).

Inclusion in this annual report of internal research projects and technical reports does not imply that these reports are available for general distribution. A list of publications available from CRM is to be published in the fall of 1984; the information necessary to order copies of these documents will also be included.

TABLE 7

Division of Externally-Funded and Joint Projects by Customer

CLIENT	PERCENTAGE
Large Industries	77.8
Small Businesses	18.9
Universities	7.7
Consultants	3.3
Government	2.4

TABLE 8

Division of R/D Resources by Region

REGION		RESOURCES	
		value $'000	(%)
01	Bas St.Laurent-Gaspesie	47.8	2.1
02	Saguenay-Lac St.Jean	739.7	31.9
03	Québec	95.9	4.1
04	Trois-Rivieres	73.5	3.2
05	Estrie	155.5	6.7
06	Montreal	174.4	7.5
07	Outaouais	104.4	4.5
08	Abitibi-Témiscamingue	433.8	18.7
09	Cote-Nord	362.4	15.6
10	Nouveau-Québec	133.1	5.7

PROCESSING OF INDUSTRIAL MINERALS

This program covers the design and development of processes for the beneficiation of Québec's industrial minerals, including silica, calcite, dolomite, talc, mica, graphite, peat, salt and granite. Industrial minerals find use in a wide variety of applications, and the processing procedure must ensure that certain characteristics demanded by a given application be met in the finished product. Businesses in this area tend to be quite small, and short of the personnel needed to provide technical support. The R/D section, with its staff of specialists, well-equipped laboratories, and pilot plant facilities, is able to contribute considerably to the development of this promising sector of the Québec mineral industry.

In 1983-84, 39 projects were undertaken in this area, representing a global value of $359,000. The minerals for which CRM's expertise was most frequently called upon were silica, calcite, mica, granite, salt and titanium pigment.

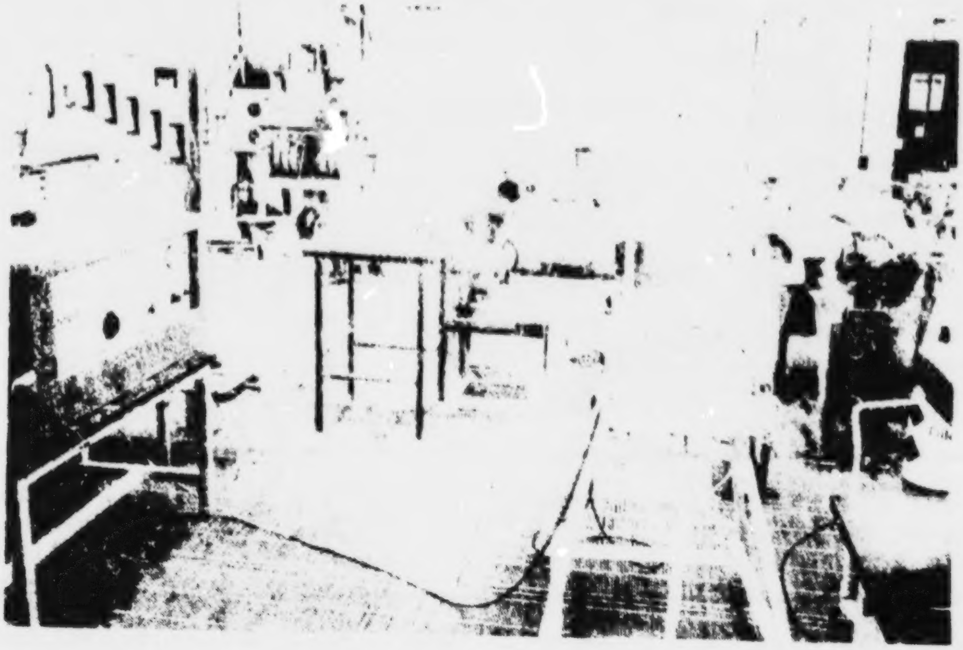
Most of the projects undertaken during the year aimed either to improve the efficiency of a process, or to diversify the production of established companies within Québec. One such endeavour allowed CRM to establish the potential of two silica deposits in Québec for the glass market and the foundry sand market. Pilot-plant studies revealed the feasibility of recovery improvements of the processing technique used for mica.
The amelioration of such a process does not necessarily involve complicated or expensive modifications. For example, the use of

simple mineralogical techniques demonstrated the feasibility of scavenging diamonds lost in granite-cutting operations, as well as recovering salt fines and asbestos dust. Industrial application of these techniques can lead to either appreciable cost reductions, or the development of new uses for a by-product.

Throughout the past year, many preliminary studies and internal research projects have been undertaken either to develop our expertise in certain less common areas, such as processing of talc and the manufacture of silicon carbide, or to increase our effectiveness and participation in areas such as granite, graphite concentration, and processing of titanium slag.

We will be futher accelerating our efforts over the coming year to improve the services offered to the industrial mineral sector.

These efforts will lead us, in collaboration with DGEGM of the Québec Ministry of Energy and Resources and with other representatives of the industry, to systematically characterize deposits of industrial minerals of certain high potentials within Québec, such as calcite. We are also developing our expertise in the usage of industrial minerals to better orient the beneficiation process towards producing the most profitable products. Finally, we will be working to identify the R/D needs of certain areas such as peat, mica, and granite, and to collaborate with private industry, CANMET, CRIQ and the universities to maximize the financial benefits of all concerned.



Overview of the wet floor, Metallurgical Laboratory, within the Research and Development Section.

TABLE 9

Research Projects - Industrial Minerals

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Purification of silica from Sainte-Clothilde (2138-2179)	ARMAND SICOTTE ET FILS LTEE	244 $12,400	G.H. Cloutier
Purification of a quartzite (2160)	ENTREPRISES LOMA LTEE	84 $4,600	G.H. Cloutier
Purification and decrepitation of silica samples (2105,2151)	SOQUEM	98 $3,900	G.H. Cloutier
Purification and agglomeration of limestone samples (2139,2144,2152)	PRODUITS CALCAIRES BEDFORD INC.	200 $10,200	R.H. Cloutier R. Tremblay
Technical aid to startup Calcite et Dolomite de Mattawin Inc. (2135)	MER	585 $26,600	G. Delisle
Limestone crushing and sampling (2126)	MER	207 $7,900	R. Vachon
Optimization of a mica ore processing method (2123,2169)	MARIETTA RESOURCES INTERNATIONAL INC.	385 $21,500	J. Turgeon
Recovery of diamonds used in granite cutting (2111)	GRANITE BUSSIERES INC.	705 $21,300	P. Belanger

Research Projects - Industrial Minerals

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Agglomeration of asbestos dust (2164)	IRDA	163 $7,200	J. Turgeon
Agglomeration of salt fines (2187)	LES MINES SELEINE INC.	72 $4,300	J. Turgeon
Purification and recycling of used acid in titanium pigment manufacture (2107,2177)	TIOXIDE CANADA INC.	640 $38,000	D. Kougiou-moutzakis
Concentration of a sample of nepheline-syenite (2120)	COMPAGNIE MINIERE IOC INC.	67 $4,100	G.H.Cloutier
	PILOT PROJECTS		
Characterization of flotation products from talc ore (2134)	BAKER TALC INC.	157 $7,500	R. Tremblay
Valorization of tailings from the Molybdenite Mine	MORONO COPPER	156 $8,300	P. Belanger
Concentration of silicon carbide (2199)	NORTON COMPANY ABRASIVES DIVISION	75 $3,300	R. Tremblay
Experimental Program to follow-up production plan in granite cutting operation (2190)	GRANICOR INC.	70 $3,400	M. Remillard

Research Projects - Industrial Minerals

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	INTERNAL PROJECTS		
Column flotation of graphite ore (2099)	------	1,138 $52,400	S. Dessureaux
Application of the LPD process to QIT titanium slag (2103)	------	340 $16,000	I. Malinsky
Heap leaching of asbestos tailings	------	733 $36,000	A.J. Plumpton
Alumina manufacture from ores other than bauxite (2085)	------	67 $4,400	G. Gabra
Evaluation of Québec Silica Deposits	CANMET Joint-Project	134 $7,700	G.H. Cloutier

Technical Reports - Industrial Minerals

BELANGER, P.

Study of the abrasive pulp of a granite producer.
June 7, 1983

BELANGER, P.

Valorization of Morono Copper tailings.
September 26, 1983

BELANGER, P.

Valorization of Aldernac mine waste piles.
October 7, 1983

BELANGER, P.

Recovery of diamonds in pulp from granite-cutting.
November 1, 1983

CLOUTIER, G.H.

Purification tests on a sample of silica.
May 27, 1983

CLOUTIER, G.H.

Concentration tests of sample nepheline-syenite.
April 19, 1983

CLOUTIER, G.H.

Extraction of nickel and iron from asbestos mine tailings.
September 29, 1983

CLOUTIER, G.H. and JACOB, A.L.

Progress report on the CANMET project to evaluate Québec silica deposits.
October 4, 1983

CLOUTIER, G.H.

Purification of Sainte-Clothide silica for the glass industry.
October 26, 1984

CLOUTIER, G.H.

Decrepitation tests on various silica samples
November 15, 1983

CLOUTIER, G.H.

Silica purification by attrition for the glass industry.
December 12, 1983

CLOUTIER, G.H.

Evaluation of a silica deposit as foundry sand.
January 27, 1984

CLOUTIER, G.H.

Preliminary purification tests of a quartzite.
February 20, 1984

Technical Reports - Industrial Minerals

DELISLE, G.

Evaluation of graphite ores.
March 30, 1983

DELISLE, G.

Status Report on the
Calcites and Dolomite of
Mattawin project.
December 2, 1983

DESSUREAUX, S.

Gravity separation of
two shipments of chromite.
November 16, 1983

GABRA, G.

Alumina manufacturing from
ores other than bauxite.
(nepheline-syenite)
May 31, 1983

KOUGIOUMOUTZAKIS, D.

Recovery of used sulpheric
acid in the TIO_2 pigment
industry.
February 28, 1983

KOUGIOUMOUTZAKIS, D.

Purification and concentration
of used sulphuric acid.
September 16, 1983

MALINSKY, I.

Application of the LPD process
to QIT slag.(pilot study)
November 25, 1983

PANNETON, J.J.

Alumina production from
ores other than bauxite.
July 25, 1983

PLUMPTON, A.J.

Preliminary economic
evaluation of a new process
to recover nickel and
manganese from asbestos
wastes and used acids.
September 14, 1983

REMILLARD, M.

Characterization and
enrichment of a limestone
deposit.
April 25, 1983

REMILLARD, M.

Planning a sampling campaign
for a granite producer.
March 28, 1984

TREMBLAY, R.

Agglomeration of limestone
dust.
September 23, 1983

TURGEON, J.

Study of the recycling of
mica middlings at Kipp-Kelly.
September 23, 1983

Technical Reports - Industrial Minerals

TURGEON, J.

Pelletizing of asbestos dust
with bentonite.
December 7, 1983

TURGEON, J.

Performance study of a
Willow crusher on a mica ore.
December 8, 1983

TURGEON, J.

Grinding and screening of
dolomitic ore.
January 25, 1984

TURGEON, J.

Pelletizing salt fines.
March 9, 1984.

VACHON, R.

Limestone crushing and
sampling.
September 16, 1983

VACHON, R.

Limestone crushing and
screening.
April 1983

VACHON, R.

Grinding of graphite.
April 1983

PROCESSING PRECIOUS METAL AND BASE METAL ORES

The precious metals sector has become the biggest in terms of production value in Québec during 1983. Intense industrial activity taking place primarily in the northwest of the province (Region 08) has led to a much greater involvement of CRM in this area.

A significant drive to market our services, and the establishment of new technologies, at CRM, which will lead to improved performance of the cyanidation process, have served to greatly increase industrial demand for our services in this sector. A seminar on gold ore processing, held at Val d'Or on March 15-16, 1984 was very successful, permitting a closer understanding among gold producers, CRM researchers, and Québec universities. It became apparent during these meetings that the industry's needs center around improved process control through the optimization of existing techniques and development of adequate instrumentation, the development of efficient and inexpensive effluent processing methods, and in the adoption of new technologies in existing installations, such as the use of activated carbon, and heap-leaching.

In 1983-84 the R/D section undertook 28 projects in the area of precious metals, with a total value of $370,400 , 59% of which were funded by the private industry.

Conventional bench-scale mineral processing tests were carried out on different potential deposits and many of these responded well to cyanidation. Other studies were performed in an effort to improve difficult processing techniques of refractory ores containing either arsenic or graphite; no significant successes resulted, but some most interesting results appear to merit further study.

During the past year the R/D section resolutely plunged into the application of new technologies to gold ore processing. Heap leaching was applied to the recovery of precious metals from the tailings of an abandoned mine, and results were so promising that the mine owner has continued the development of the process. Another contract was awarded to a Val d'Or company to explore the potential application of this same method to some of the low-grade ores in the northwest. The potential use of activated carbon to extract precious metals from leaching solutions has led us to acquire and install the laboratory equipment necessary to apply this technique. In addition, the possibility of using the only Canadian-produced activated carbon is being evaluated, through gold extraction tests in the laboratory. A comparative study of five different activated carbon products available on the market is presently being carried out, and testing of several different techniques for gold elution is underway.

Next year, we plan to increase our participation in the area of precious metals in collaboration with the northwest's gold producers. The optimization of the fusion process of gold precipitates, the use of carbon-in-pulp techniques and of heap-leaching at existing facilities, and the processing of cyanided effluents will be the main areas of activity. While continuing to offer our laboratory services for processing tests on potential deposits, we plan to improve our cyanidation pilot circuit to a capacity of 225 kg/h through modernization and the addition of a carbon-in-pulp circuit. This will enable us to establish the metallurgical balance of cyanidation, which demands the processing of many tonnes of ore to obtain the necessary precision of the results. Finally, it must be mentioned that our autogeneous grinding pilot circuit is now operational, and that the associated instrumentation makes it an extremely effective test circuit. This equipment could already be put to good use in establishing the amenability of such grinding techniques for new plants being designed on the basis of semi-autogeneous grinding. We are continuing our study of the potentials of hydrometallurgical or electrometallurgical processing of auriferous chalcopyrite ores from the Chibougamou region, through a research contract awarded to Laval University.

TABLE 10

Research Projects - Precious Metal and Base Metal Ores

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Cyanidation of Pascalis ore (2102)	SOQUEM	462 $28,500	G. Delisle
Flotation and cyanidation of Win-Eldrich ore (2163)	SOQUEM	198 $10,100	P. Belanger
Processing of Cronoir ore (2170, 2205)	MINES SULLIVAN INC.	374 $20,500	G. Delisle
Flotation and cyanidation of auriferous pyrite (2191)	ABBDL-TECSULT INC.	485 $17,600	J. Dionne R. Tremblay
Gold extraction from Perron Mines ore (2186)	MINES D'OR PERRON INC.	85 $4,000	R. Tremblay
Analysis and batch tests of cyanidation	LES MINES DORVAL LTEE	466 $24,800	J. Perusse
Sampling of drill cores from the Tiblemont deposit (2182)	CORPORATION D'EXPLORATEURS DE QUEBEC LTEE	430 $11,400	J. Perusse
Flotation processing of arsenopyrite ores from Kewagama (2181)	MINERAUX SULPETRO LTEE	222 $11,400	J.Dionne
Recovery of silver in tailings from the old New Calumet mine (969,2168)	J. McLATCHY	153 $8,000	M.Therien

Research Projects - Precious Metal and Base Metal Ores

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Heap-leaching of tailings from the old Montauban mine. (2161)	MARCOR TAILINGS ET AL	206 $17,300	D. Kougiou-moutzakis
Elimination of cyanide from gold ore processing effluents. (2173)	ROCHE ET ASSOCIES	321 $17,300	G. Gabra
Evaluation of activated carbon CNS-211 (2178)	A. C. CARBONE INC.	168 $8,600	D. Kougiou-moutzakis
Identification of mineral bearing ores and sources of losses in precious metals. (2174)	NORANDA DIV. MATTAGAMI	269 $10,900	M. Therien
Processing of exhausted electrolyte and production of ammonium sulfate. (2098)	ZINC ELECTROLYTIQUE DU CANADA LTEE	139 $7,700	D. Kougiou-moutzakis
Feasibility study of tungsten recovery from a precious metal deposit. (2194)	ABBDL-TECSULT INC.	249 $10,400	M. Therien

Research Projects - Precious Metal and Base Metal Ores

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	PILOT PROJECTS		
Characterization of Kewagama mine samples (2130)	MINERAUX SULPETRO LTEE	36 $4,000	G. Gabra M. Therien
Relation between gold grades and the pyrite content of Sigma mine ore (2143)	LES MINES SIGMA LTEE	73 $3,900	G. Delisle
Characterization of the effect of graphite on gold losses. (2146,2156)	MINES AGNICO-EAGLE	270 $11,900	M. Therien
Heap-leaching of Montauban tailings (2122)	MARCOR TAILINGS ET AL	115 $5,800	D. Kougioumoutzakis
Processing of gold slag (2142)	CORPORATION TECK DIVISION LAMAQUE	126 $7,100	G. Delisle
	INTERNAL PROJECTS		
Use of thiourea for leaching precious metal ores.(2039, 2112)	------	946 $42,400	G. Gabra
Recovery of gold from pyritic tailings (2127)	------	246 $10,000	G. Gabra

Research Projects - Precious Metal and Base Metal Ores

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
INTERNAL PROJECTS			
Concentration by flotation of tungsten minerals from tailings from Québec ore-processing plants. (2081)	------	100 $8,160	M. Therien
Use of activated carbon to recover gold from leaching solutions. (2040,2088)	------	1,066 $52,300	D. Kougioumoutzakis J. Dionne

TECHNICAL REPORTS - Precious Metal and Base Metal Ores

BELANGER, P.

Flotation of auriferous pyrite from the Win-Eldrich deposit.
January 27, 1984

DELISLE, G.

Preliminary cyanidation tests.
April 21, 1983

DELISLE, G.

Tailings from Granada mine.
April 25, 1983

DELISLE, G.

Processing of gold ore from Pascalis.
August 10, 1983

DELISLE, G.

Examination of slag from fusion of precipitates of Lamaque gold.
January 25, 1984

DELISLE, G.

Relation between the concentrations of gold and nuggets in tailings.
February 7, 1984

DELISLE, G.

Processing of gold ore from Cronoir.
February 16, 1984

GABRA, G. and PANNETON, J.J.

Technological solutions for the control of gaseous SO_2 emissions - Noranda smelter.

GABRA, G.

Use of thiourea for gold and silver extraction in three samples from Camchib Ltd.
May 11, 1983

GABRA, G.

Study of the kinetics of dissolution of gold from pyrite concentrate with acidified thiourea.
July 29, 1983

GABRA, G.

Extraction of gold from a concentrate of chalcopyrite using thiourea.

GABRA, G. and THERIEN, M.

Characterization of ore samples from Kewagama mine.
October 4, 1983

GABRA, G.

Recovery of gold from thiourea liquors using resins.
November 28, 1983

TECHNICAL REPORTS - Precious Metal and Base Metal Ores

GABRA, G. and PANNETON, J.J.

Elimination of cyanides
in effluents from gold
ore processing.
(exploratory study)
December 2, 1983

GABRA, G. and PANNETON, J.J.

Elimination of cyanide
in effluents from gold
ore processing.
January 27, 1984

GABRA, G. and DELISLE, G.

Recovery of gold in the
pyrite from cyanidation
tailings.
March 15, 1984

KOUGIOUMOUTZAKIS, D.

Processing of exhausted
electrolyte from ammonium
sulfate production.
July 14, 1983

KOUGIOUMOUTZAKIS, D.

Heap-cyanidation of
Montauban tailings.
September, 1983

KOUGIOUMOUTZAKIS, D.

Comparative study of gold
recovery with activated
carbon CNS-211.
February 20, 1984

KOUGIOUMOUTZAKIS, D.

Heap-leaching of
concentrator tailings from
the old Montauban mine.
February 29, 1984

NAGAMORI, M.

Analysis of the DEXTEC process
June 10, 1983

PERUSSE, J.

Analysis of batch
cyanidation of Val d'Or ore.
March 13, 1984

THERIEN, M.

Review of work on silver
recovery from the tailings
of an old concentrator.
June 3, 1983

THERIEN, M.

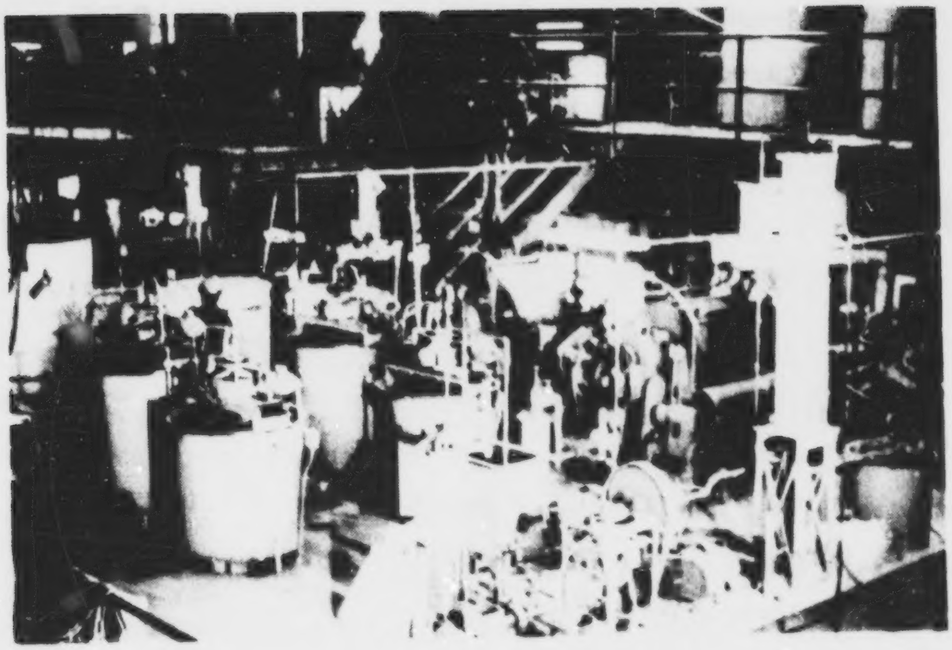
Characterization of
graphite-bearing products
of the Agnico-Eagle
number 1 and 2 decanters.
December 22, 1983

THERIEN, M.

Identification of potential
tungsten-bearing deposits
in Québec.
November 30, 1983

TREMBLAY, R.

Extraction of gold from ore
from Mines d'Or Perron Ltee.
March 5, 1984



Installations for Gold Processing by Cyanidation at the Pilot Plant

PROCESSING OF IRON ORES AND ASSOCIATED ELEMENTS

This sector of the industry, which continued to be very depressed throughout 1983-84, received much attention from MER. The active participation of CRM in the study-group assembled under the auspices of the "Table de Concertation sur l'industrie de Fer" (Round-table discussions on the Iron Industry) in May 1983 enabled us to define the possibilities for R/D as means of revitalizing this sector in the medium and long-term. More than twenty priority projects were identified by producers, which would cost over $10 million, but which could bring returns of over $100 million if successful.

Following these initiatives, the R/D directorate elected to increase its activity in this area, and a project coordination group was established. This group defined a number of objectives for CRM research in this area:

- lowered production costs;
- increased productivity of concentrators and of pelletizing plants;
- improved product properties for use in blast-furnaces; both of the pellets and the concentrate for agglomeration.

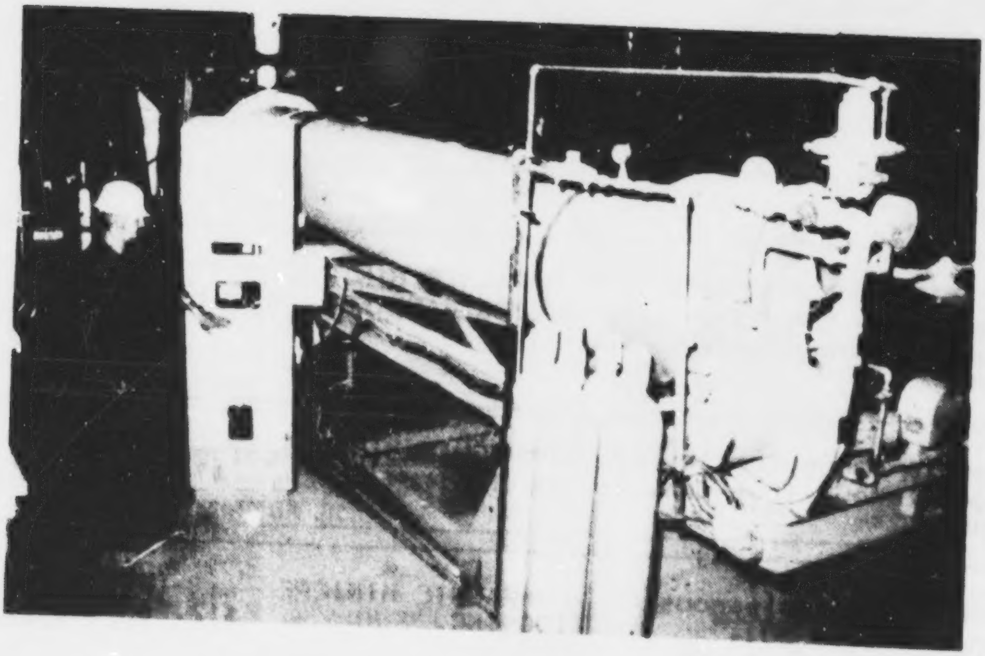
During the last year, many efforts were directed towards the preparation of work programs compatible with producer's needs, and several experimental installations were assembled, such as the pellet pot-grate apparatus, a device for measuring the reductibility and expansion of pellets and sinters and a device to study their strength during reduction. Other devices are planned and will be installed during the coming year, such as the sinter pot-grate apparatus, and a device to study the properties of pellets and sinters at very high-temperatures. Combined with the vast experience of our scientific personnel, the test equipment presently in operation makes CRM a center of excellence in the iron field.

We are at an early stage in organizing our activities within this sector, which explains the relatively low $350,000 which was devoted to this sector during 1983-84, and the fact that only 40% of the projects were undertaken with industrial funding.

However, it should be emphasized that testwork on pelletizing with peat continued in the pilot plant, and on-site industrial-scale testwork was also carried out. Also, the study of the effects of peat on the mechanisms of baking of pellets and on their metallurgical properties continued through a contract awarded to Ecole Polytechnique in Montreal. The next stage, development of a full-scale process, depends on the development of a practical and cost-effective method to mine and prepare the peat. More fundamental studies into the characteristics of the concentrate revealed certain factors which limit the reductibility of a certain producer's acid pellets; this will allow that producer to estimate the anticipated benefits resulting from the modification of his pelletizing operating conditions. In another area, laboratory tests on the sedimentation of concentrator wastes of one producer have shown excellent promise in clarifying the red-coloured effluent water which causes environmental problems, and also reduces the separation efficiency of spiral concentrators. The application of this method seems likely.

R/D activities in the iron ore area promise to be very intense in the coming months. On one hand, many projects aiming at cost reduction are being undertaken: optimization of spiral concentrators, reduction of energy costs, pelletizing with coke and with peat, and the reduction of costs incurred in regrinding of concentrates for pelletizing, are examples of projects which are to be undertaken next year. As well, the availability of an efficient autogeneous crushing circuit in the pilot plant will certainly lead to projects to optimize this grinding technique, which is a key factor in production costs at the industrial scale. On the other hand, many projects will cover either the improvement of quality of products already on the market, or the demonstration of the high-quality of the pellets currently produced in Québec-Labrador as compared to pellets produced by competing manufacturers. A systematic experimental program will be undertaken to demonstrate the usefulness of Québec-Labrador specularite in micropelletizing and in sintering. This project will involve the cooperation of Ecole Polytechnique through a contract. Also, the improvement of the high-temperature properties of pellets in a blast furnace will be another top priority area for the R/D section. Looking at long-term development, CRM has agreed to support and collaborate with

McMaster University in Hamilton, in a project aimed at developing a totally new kind of pellet. Finally, CRM's continued participation in the Canadian committees of the International Standards Organization dealing with iron ore and pre-reduced iron is another way to support and sustain the quality of the Québec-Laborador iron ores.



The pilot plant's Continuous Rotary Kiln is used, among other things, for the production of cement.

TABLE 11

Research Projects - Iron ore and Associated Elements

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Continuing testwork of pelletizing with peat. (2018)	SIDBEC-NORMINES INC.	475 $24,214	J. Turgeon
Mechanisms affecting the reducibility of iron pellets. (2145, 2183)	SIDBEC-NORMINES INC.	964 $40,516	I. Malinsky M. Remillard
Evaluation of the magnetic upgrading of Mont Wright concentrate. (2090)	SIDBEC-NORMINES INC.	110 $8,800	G.H. Cloutier
Grindability index of Mont Wright ore (2090)	COMPAGNIE MINIERE QUEBEC CARTIER	269 $10,200	R. Tremblay
Clarification of red-waters from the Mont Wright concentrator. (2158)	COMPAGNIE MINIERE QUEBEC CARTIER	104 $4,600	R. Tremblay
Magnetic concentration of manganiferous iron ore. (2180)	COMPAGNIE MINIERE IOC INC.	140 $7,700	J.J. Panneton R. Tremblay
Leaching manganiferous iron ore with SO_2. (2155)	COMPAGNIE MINIERE IOC INC.	189 $12,200	J.J. Panneton

Research Projects - Iron ore and Associated Elements

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	PILOT PROJECTS		
Literature survey of steel consumption in grinding.(2220)	SIDBEC-NORMINES INC.	163 $6,900	G.Paquet
Potential manganese extraction from manganiferous iron ore. (2106, 2087)	COMPAGNIE MINIERE IOC INC.	339 $23,000	R. Tremblay P. Belanger J.J. Panneton
Leaching a ferromaganese slag. (2108)	UNION CARBIDE OF CANADA INC.	266 $16,900	J.J. Panneton
	INTERNAL PROJECTS		
Abrasion and corrosion phenomena of grinding media. (2092, 2068)	------	528 $26,500	R. Tremblay S. Dessureaux
Measuring properties of iron pellets and sinters. (2125)	------	478 $23,500	I. Malinsky
Specularite sintering. (2159)	------	143 $7,500	M. Nagamori
Development and optimisation of a pot-grate test unit. (2091)	------	1,446 $63,300	J. Turgeon
Valorization of iron oxides by pelletizing. (2066)	ECOLE POLYTECHNIQUE (Joint project)	238 $13,500	I. Malinsky

Technical Reports - Iron Ores and Associated Elements

BELANGER, P.

Bench-scale concentration
method on manganese
from Schefferville.
March 13, 1983

BELANGER, P.

Concentration of manganese
in Schefferville ore.
July 28, 1983

CLOUTIER, G.M.

Magnetic separation tests
on concentrates from
Mont Wright and Fire Lake.
June 6, 1983

DESSUREAUX, S.

Study of corrosion of
grinding media.
July 29, 1983

DESSUREAUX, S.

Abrasive and corrosive
phenomena of grinding media.
September 9, 1983

GODIN, E. (Ecole Polytechnique)

Valorization of iron
oxides by pelletizing.
September 15, 1983

MALINSKY, I.

Study of relationships between
properties and composition of
fully-fluxed iron pellets.
November 7, 1983

PANNETON, J.J.

Manganese recovery by leaching
ferro-manganese slag with
used sulphuric acid.
July 29, 1983

PANNETON, J.J.

Leaching manganese from
iron ores from IOC INC.
July 29, 1983

PANNETON, J.J.

Study of valorization of the
low-grade manganese deposits
of IOC INC.
July 29, 1983

PANNETON, J.J.

Leaching manganiferous
iron ore using SO_2
(preliminary study)
January 27, 1984

PANNETON, J.J and TREMBLAY, R.

Magnetic concentration of a
pre-reduced manganiferous ore.
March 1, 1984

Technical Reports - Iron Ores and Associated Elements

REMILLARD, M.

Correlation of parameters affecting reductibility of pellets from Sidbec-Normines.
January 25, 1984

TREMBLAY, R.

Study of the consumption of grinding media.
April 25, 1983

TREMBLAY, R.

Use of peat as a binding agent in pelletizing.
May 30, 1983

TREMBLAY, R.

Clarification of red-waters.
March 9, 1984

TURGEON, J.

Peat-grinding trials and pelletizing with ground peat.
June 15, 1983

TURGEON, J.

Development of operating conditions for the pot-grate test equipment.
December 22, 1983

PROCESSING NIOBIUM ORES AND ASSOCIATED ELEMENTS

Québec is second only to Brazil (the world's largest) as a niobium producer, and is currently the only exporter of pyrochlore concentrate. Other promising deposits have yet to be developed. CRM has been involved in this sector for many years, both in the enrichment of the deposit presently being exploited (Niobec) and in the development of other deposits, and the perfection of pyrochlore processing methods.

A round table discussion held at CRM in January 1984 brought together nineteen representatives of Québec's niobium industry. Discussions centered around perspectives for further development of this industry in the medium term. It was concluded that niobium is a metal which offers much development potentials, but that efforts must be taken to consolidate our position with respect to the imposing Brazilian output.

Once more in 1983-84, this area occupied most of the efforts of the scientists in the R/D section, consuming 37% of the resources, and $785,000. A large proportion of this work was carried out through industrially-supported projects (88%) for the development, both at the bench-scale and in the pilot plant, of a flotation method to concentrate niobium-tantalum ore from the Crevier deposit, and for various tests to establish the potential of the complex Strange Lake ore. Work on the development of an original process of niobium oxide extraction from pyrochlore concentrate continued, and a Canadian patent is pending. This process will serve, among other things, to treat tantalum-rich pyrochlore concentrate, such as those found in the Crevier deposit.

Work on valorization of the Crevier deposit was the single biggest project of the R/D section in 1983-84. During the first part of the year, tests on a bench-scale continued and led to the development of a flotation-based process which produces a good grade of concentrate. These encouraging results led to tests at the pilot plant scale to verify the applicability of the process on a semi-industrial scale and to prepare a quantity of concentrate sufficient to complete the laboratory tests. These pilot tests were undertaken over a period of the last five months of 1983-84. They resulted in the identification of certain critical constraints such as the amount of reagents used and in the specifications of equipment. While many stages of the project were completed, problems arising in the final stage of concentrate preparation forced the temporary suspension of pilot tests. These processing problems are to be carefully scrutinized at the bench-scale and the concentrate preparation work at the pilot plant should resume within several months.

As well, during the coming year, CRM will undertake work on the Strange Lake project, the development of which is very complex, demanding the combined efforts of a laboratory consortium.

Finally, work on the installation of a liquid-liquid extraction pilot circuit will continue, which will greatly increase the potentials of hydrometallurgical pilot-scale experimentation. Another study contracted to McGill University, aiming at separating pyrochlore fines by column flotation, will continue and its success would bring a considerable recovery improvement for the processes currently in use.

TABLE 12

Research Projects - Niobium and Associated Elements

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Laboratory development of a processing method for Crevier ore. (2011)	SOQUEM	4,711 $194,300	G. Delisle R. Tremblay
Pilot plant development of a processing method for Crevier ore. (2157)	SOQUEM	8,390 $412,900	S. Dessureaux
Pilot plant preparation of Strange Lake ore. (2031, 2097, 2118, 2131)	COMPAGNIE MINIERE IOC INC.	534 $28,200	S. Dessureaux
Preliminary study of leaching Strange Lake ore with HCl. (2117)	COMPAGNIE MINIERE IOC INC.	183 $12,600	J.J. Panneton
Gravity separation of leaching tailings from Strange Lake ore. (2128)	COMPAGNIE MINIERE IOC INC.	437 $17,800	R. Tremblay
Physical concentration of Strange Lake ore.	COMPAGNIE MINIERE IOC INC.	330 $18,200	A.J. Plumpton

Research Projects - Niobium and Associated Elements

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	PILOT PROJECTS		
Elutriation and flocculation of the -10 micron fraction of Strange Lake ore. (2093, 2100)	COMPAGNIE MINIERE IOC INC.	228 $11,800	M. Therien
Exploratory studies of flotation of columbite from St-Honore ore.(2195)	LES ENTREPRISES TMG INC.	56 $1,900	R. Tremblay
	INTERNAL PROJECTS		
Method of manufacturing pure niobium oxide. (2104, 890, 2101)	------	812 $52,900	J. Perusse J.J. Panneton
Pyrochlore collection using chelating agents. (2089)	------	94 $5,000	M. Therien
Flotation of very fine pyrochlore ores. (2148)	------	247 $11,100	A.J. Plumpton
Recovery of Th, Sr and some rare earths from pyrochlore wastes at St-Honore. (2114)	------	457 $12,200	B. Provencher G. Gabra

Technical Reports - Niobium and Associated Elements

DESSUREAUX, S.

Grinding Strange Lake ore to 200 mesh.
August 26, 1983

DESSUREAUX, S.

Gravity separation of two samples of Strange Lake ore.
September 9, 1983

DESSUREAUX, S.

Flotation testwork on Strange Lake ore.
November 16, 1983

DESSUREAUX, S., VACHON, R. and DELISLE, G.

Piloting of Crevier ore. (progress report)
February 2, 1984

PANNETON, J.J.

Leaching of Strange Lake ore using HCL.
November 25, 1983

PANNETON, J.J.

Hydropyrolysis and calcination of niobium composites.
January 27, 1984.

PERUSSE, J.

Pilot plant production of pure niobium oxide using pyrochlore concentrate: maximum niobium oxide concentration during the organic phase of extraction and the aqueous phase of re-extraction.
July 1983

PROVENCHER, B.

Recovery of Th, Sr, and some rare earths from pyrochlore leaching residues.
August 12, 1983

THERIEN, M.

Preliminary study of flotation of fines from Strange Lake with hydrocyclone overflow.
May, 1983

THERIEN, M.

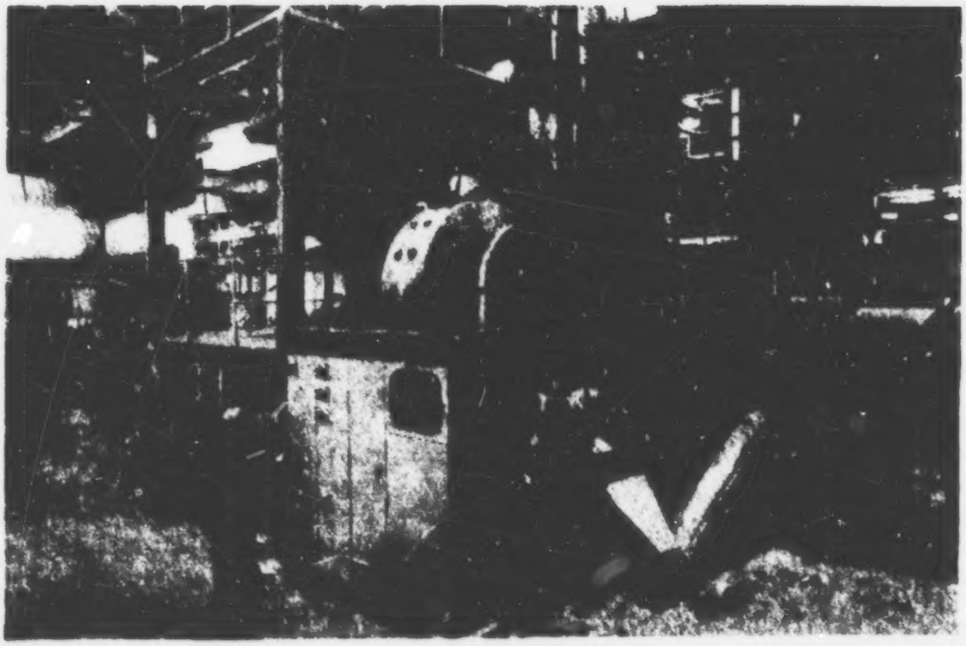
Preliminary study of elutriation of slimes from Strange Lake with hydrocyclone overflow.
September 30, 1983

TREMBLAY, R.

Solubility of calcium and manganese in Strange Lake ore.
September 16, 1983

TREMBLAY, R.

Gravity separation
of pyrochlore in leaching
wastes from Strange Lake ore.
December 8, 1983



Autogeneous mill at the pilot plant

Other Projects

The R/D section directs some of its efforts to projets which do not directly concern specific minerals and which, in general, come under the traditional heading of ore processing.

In 1983-84, thirteen (13) projects with a total value of $340,000 were undertaken in this area.

Except for a project on valorization of incinerator ashes, and another on the development of new applications for lignosulfates in mineral processing, the majority of these projects were undertaken as internal projects.

Much effort was devoted to the development of computer applications, both in CRM management, and in optimizing metallurgical processes. In the latter area, Laval University undertook, under contract, the development of simulation software and the optimization of mineral treatment processes such as grinding and classification, metallurgical balance calculation, and the control of flotation circuits.

The transfer of this technology, developed by GRAAIM, is assured at CRM by the use of software available by virtue of the studies it undertakes, and by a project to extrapolate a prediction method for the grinding efficiency at the pilot scale, from simple laboratory test results. This project, while increasing the efficiency of the pilot plant, allows our R/D professionals to acquire this expertise and consequently, to transfer it to the Québec mineral industry.

The year 1983-84 witnessed the beginning of CRM involvement in the application of plasma technology to mineral processing. The activity consisted of familiarization with this new area which offers great potentials in Québec due to the availability of abundant hydro-electric energy, and in giving technical advice on various projects submitted by the universities and various other groups.

Finally, an imposing file covering all the expertise acquired at CRM on vanadium extraction has been compiled and distributed among interested parties in this sector.

Throughout the next year, our efforts in the area of computer applications will grow, and will be directed more specifically towards technology transfer to active producers, and to the development of methods based on automation, and increased use of instrumentation.

Efforts will continue to develop our expertise in plasma technology within Québec, particularly through our collaboration with the Hydro-Québec Research Center (IREQ) (Institut de Recherche de l'Hydro Québec) and with university groups already active in the area.

TABLE 13

Other Research Projects

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Beneficiation of incinerator ashes. (2133)	LES ENFOUISSEMENTS SANITAIRES DE QUEBEC INC.	190 $15,800	J.J. Panneton
Use of lignosulfates in mineral processing. (2133)	TEMFIBRE INC.	49 $4,200	R. Tremblay
	INTERNAL PROJECTS		
Application of data processing to management and operation of CRM (2080, 2109)	------	1,024 $54,800	M. Remillard
Improvement and optimization of high-intensity magnetic separation in the laboratory. (2070)	------	702 $26,300	G.H. Cloutier
Installation and adjustment of high temperature equipment at the pilot plant. (2113)	------	250 $13,900	M. Nagamori
Use of plasma in mineral processing. (2137)	------	240 $14,000	M. Nagamori

Other Research Projects

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
INTERNAL PROJECTS			
Prediction of pilot plant grinding tests from laboratory results. (2033)	Laval University (Joint Study)	2,083 $90,500	M. Remillard R. Vachon

Technical Reports - Various

GABRA, G.

Extraction of free mineral acids with organic solvents.
August 19, 1983

LAMBERT, J.

High intensity magnetic separation tests with a Jones machine.
September 20, 1983

MALINSKY, I. and CASTONGUAY, G.

Vanadium file.
October 5, 1983

NAGAMORI, M.

Fusion of Fe-Ni concentrate in a plasma furnace: theoretical study.
September 8, 1983

PANNETON, J.J.

Beneficiation of incinerator ashes 1. Chemical analysis of samples.
July 29, 1983

PANNETON, J.J.

Beneficiation of incinerator ashes.
July 29, 1983

REMILLARD, M.

Rapid estimation of the grindability index of an ore.
November 4, 1983

REMILLARD, M. and VACHON, R.

Simulation of mineralogical processes. (SPOC)
December 20, 1983

REMILLARD, M

Normalization of standard determinations.
March 6, 1984

THERIEN, M. and REMILLARD, M.

Determination of maximum particle sedimentation rates using a standard program in the APL programming language.
March 1, 1984

TREMBLAY, R.

Use of lignosulfates in mineral processing.
September 14, 1983

FUTURE PERSPECTIVES

The objectives of the R/D section during 1984-85 aim essentially to continue and consolidate the efforts of 1983-84. To this end:

- Efforts to market our services and to direct our projects towards the resolution of problems currently encountered by industry will continue in order to maximize the benefits of our efforts;

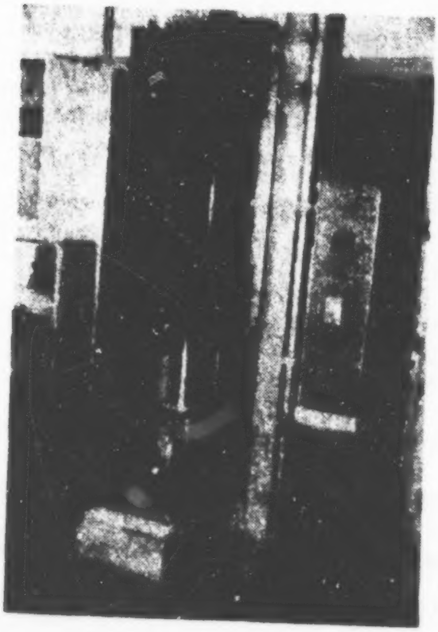
- activities devoted to projects funded by industries in the mineral sector should increase and make up 70% of the funding for CRM projects;

- in the area of iron ore processing, sizeable projects are to be undertaken into the optimization of current processes, with the aim of reduced costs and to improve the competitive standing of Québec-Labrador producers with respect to international competition;

- in the area of precious metal ores, work to coordinate the efforts of producers in the northwest continues, and the application of newly available technologies will be promoted, with the aim of continuing the remarkable development of this rapidly expanding sector;

- our activities in the area of industrial minerals and the control of mineral processing techniques will be restructured so as to increase our involvement in this sector and to better respond to the demands of the industry;

- collaboration with universities and research organizations in Québec will be emphasized with the aim of advancing our expertise in certain areas, providing scientific relief for the mineral industry, and in the case of regional organizations, to orient ourselves more to the specific needs of particular clients in these regions.



Reductability furnace at the pilot plant.

ANALYSIS AND CONTROL

Director:

Marc Pichette

Head of Chemical Section:

Jean Guimont (since July 1983)

Head of Physical and Mineralogical Section:

Simon Turmel (since August 1983)

GENERAL OBJECTIVES

The Analysis and Control (A/C) section exists for the benefit of all parties involved in Québec's mineral sector; different departments within the Mines Branch of the Québec Ministry of Energy and Resources (MER); mining companies involved in exploration, extraction, and processing; individual prospectors; crown corporations, and universities. The section aims to promote the discovery, evaluation, and processing of Québec's mineral wealth through two well-defined activities: mineral analysis, and analytical research.

PRINCIPAL CONTRIBUTIONS

In 1983-84, the A/C section provided a variety of specialized analytical services, applying techniques as often mineralogical as chemical or physico-chemical. In addition, its consultation and analytical research service was made available to the mineral sector to solve analytical problems acknowledged by several sources.

From the analytical viewpoint, the past year has been excellent. Considering only internal work, 45,923 different samples were analyzed in our laboratories, representing a record number of 770,164 determinations and studies. On the other hand, as demand far exceeded our capacity, 367,904 analytical determinations, mostly for relatively simple hydrogeochemical determinations, had to be sent to commercial laboratories. Together, the total number of results provided to the mineral industry was over one million (1,138,069).

More than 80 different parameters including close to sixty elements have been detected in a wide variety of mineral substances, both liquid and solid: ores, minerals, rocks, sediments, soils, interstitial waters, mine tailings, drill cores, filter-media, alloys and leaching products. The concentration of detected elements varied from fractions of parts per billion (ppb) up to almost 100%. This wide variety of samples, coupled with their extreme range of concentrations, required the use of 16 different analytical techniques.

The vast majority of our analytical work was carried out for MER's Mineral and Geological Exploration directorate (DGEGM) (Direction General de l'Exploration Geologique et Minerale) to provide the essential analytical results that enabled the group to further its studies of the geological makeup and the mineral potentials of Québec's vast hinterland.

Indispensable analytical results were also provided to the CRM Research and Development (R/D) section, to enable them to control, direct, and conclude 106 research projects undertaken to promote the beneficiation, transformation and utilization, of the province's mineral deposits.

Analytical work was also carried out to assist individual prospectors and mining companies in the exploration, mining, and processing of Québec's mineral wealth.

While most mining companies involved in exploitation and processing have their own laboratories, the size and capabilities of each one varies greatly with the size of the company. Inferior laboratory equipment can severely limit the quality of technical work. Added to this is the fact that the main duty of any analytical laboratory is to complete the analyses of the numerous samples which arrive every day. Occupied with routine tasks, its staff has little time to devote to improvement of their analytical procedures or to the development of new ones.

In light of these difficulties, the A/C efforts in analytical research have revealed solutions to several analytical problems acknowledged by the industry, and have provided responses to the mineral sector's most complex analytical requests. This research has also contributed to the improvement of analytical accuracy, and to the range of available services through the improvement of analytical procedures. In particular, the application of plasma atomic emission spectrometry to the detection of major and minor elements in rocks and the introduction of various automated systems have contributed significantly to improved productivity, despite a staff cutback. A total of 26 analytical research projects were completed in-house during the year, and two other projects were performed by universities.

The A/C section, an internationally recognized laboratory specialized in mineral analysis, was invited during the year by the London-based Institute of Geological Sciences to participate in a cooperative study leading to the establishment of new analytical standard reference materials.

A symposium on A/C activities was held for MER geologists on November 1, 1983. This event brought together almost forty participants and covered topics such as X-ray diffraction spectrometry and analysis of rocks by plasma atomic emission spectrometry.(PAES) The meeting ended with a presentation on the capabilities of PAES and fire assay.

Two publications on analytical methods were prepared during the year, entitled "Procedures for Detecting Trace Elements in Sediments, Rocks and Water", and "Analytical Procedures for Rocks and Ores with Atomic Absorption Spectrometry". These publications were distributed primarily to interested parties in the sectors likely to be involved in mineral analysis, notably to private laboratories specializing in this area within Québec . No doubt these procedures will be greatly appreciated by them.

The A/C geochronology laboratory, dedicated to dating carbon-bearing samples by the ^{14}C method, ceased all activity during 1983-84. Considering the high cost of the scientific equipment involved, and of the painstaking development of expertise, it was decided to preserve these valuable resources, and to maintain service to MER scientists, by transferring the developed technology to the Center for Northern Studies at Laval University. The participation of the A/C group in the creation of the new laboratory consisted not only in the loan of specialized equipment, but also in technical and scientific support to rapidly establish the new ^{14}C dating service consistent with proven quality criteria.

Three oral presentations were made by A/C scientists at congresses or conferences during the year, and one paper was sent to the editor of a specialized publication.

ORGANIZATION/PERSONNEL/EXPENDITURES

The A/C section consists of two distinct administrative entities: the Chemistry section and the Physics/Metallurgy section. Its operating budget was $2,704,300, not including $707.000 from the Mines Branch "Program 10" which was used to fund analytical contracts awarded to private laboratories. As of March 31, 1984, the staff of the section included 47 full-time and six part-time employees for a total of 53 people, including three administrators, twelve professionals, three office workers, and thirty-five technicians and specialized workers.

The Chemistry Section included 27 permanent employees distributed among four (4) operational sub-sections. Three of these sub-sections were involved primarily with analyses, while the fourth directed its efforts towards analytical research. The regular operating budget of this section reached $1,323,600.

The Physics/Metallurgy Section employs 17 people, also divided into four sub-sections. In addition to its analytical and research activities, this group has the responsibility for the harmonious introduction of computers into all the administrative areas of CRM. The section's budget was $1,008,600 during 1983-84.

SUMMARY OF ACTIVITIES

Mineral analysis, analytical research, and research in computers/instrumentation constitute the three activities of the A/C Section. As shown in Figure 3, mineral analysis was the dominant activity, consuming 74.0% of total A/C expenditures, while the others accounted for 20.7% and 5.3% respectively.

MINERAL ANALYSIS

The performance of A/C in mineral analysis was quite remarkable in 1983-84, with production reaching unprecedented levels in a record number of 770,164 determinations and studies, as shown in Figure 2. In fairness, it should be noted that analytical throughput during any year is a reflection, in part, of the geochemical activity of DGEGM. Last year's record achievement is no exception to this rule.

This record accomplishment would not have been possible but for the diligence of our staff, who deserve a good part of the credit. Four other factors explain this success:

- Improved working conditions in 1983-84 compared to the previous year;
- Dividends from analytical research, leading to the installation of high-performance analytical systems during 1983-84;
- Overtime work to produce most of the analytical results for MER Geological uses before March 31, 1984;
- Improved management with the appointment of two qualified managers to operational services at the beginning of the year.

It should also be noted that this increase in output came about despite a considerable decrease in the number of permanent staff (8%).

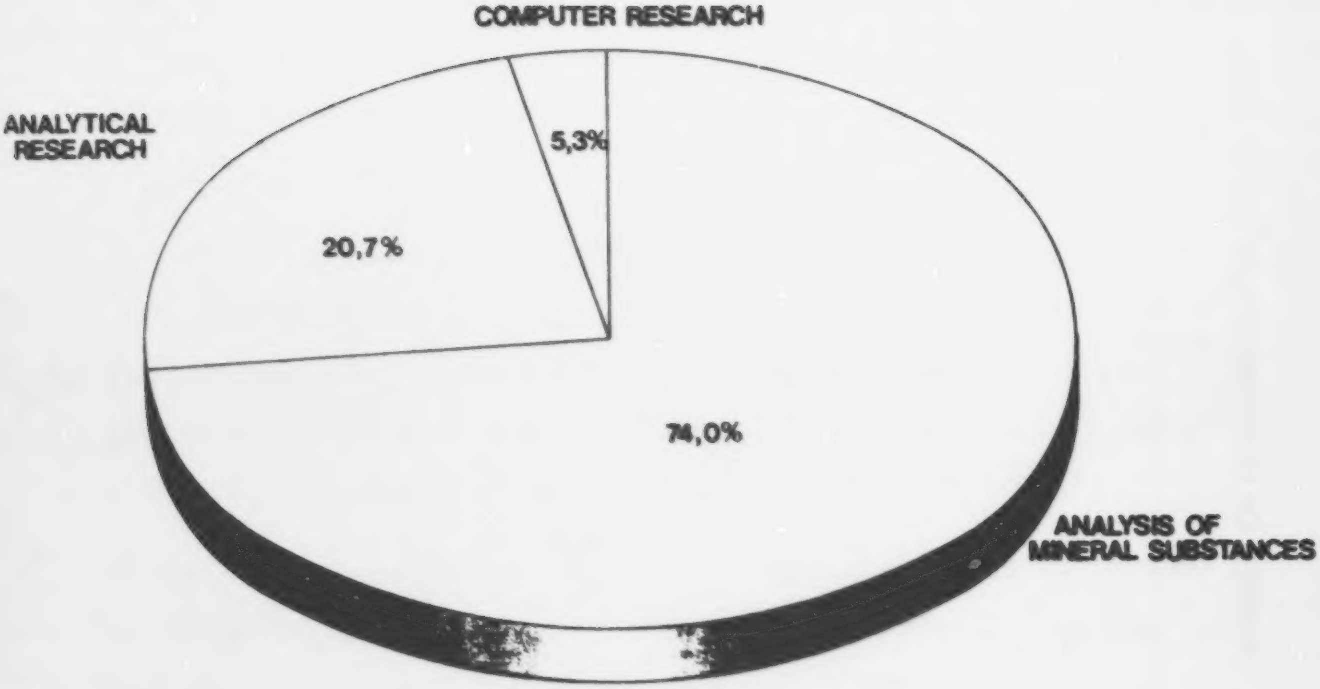


Figure 1. A/C Expenditures by activity

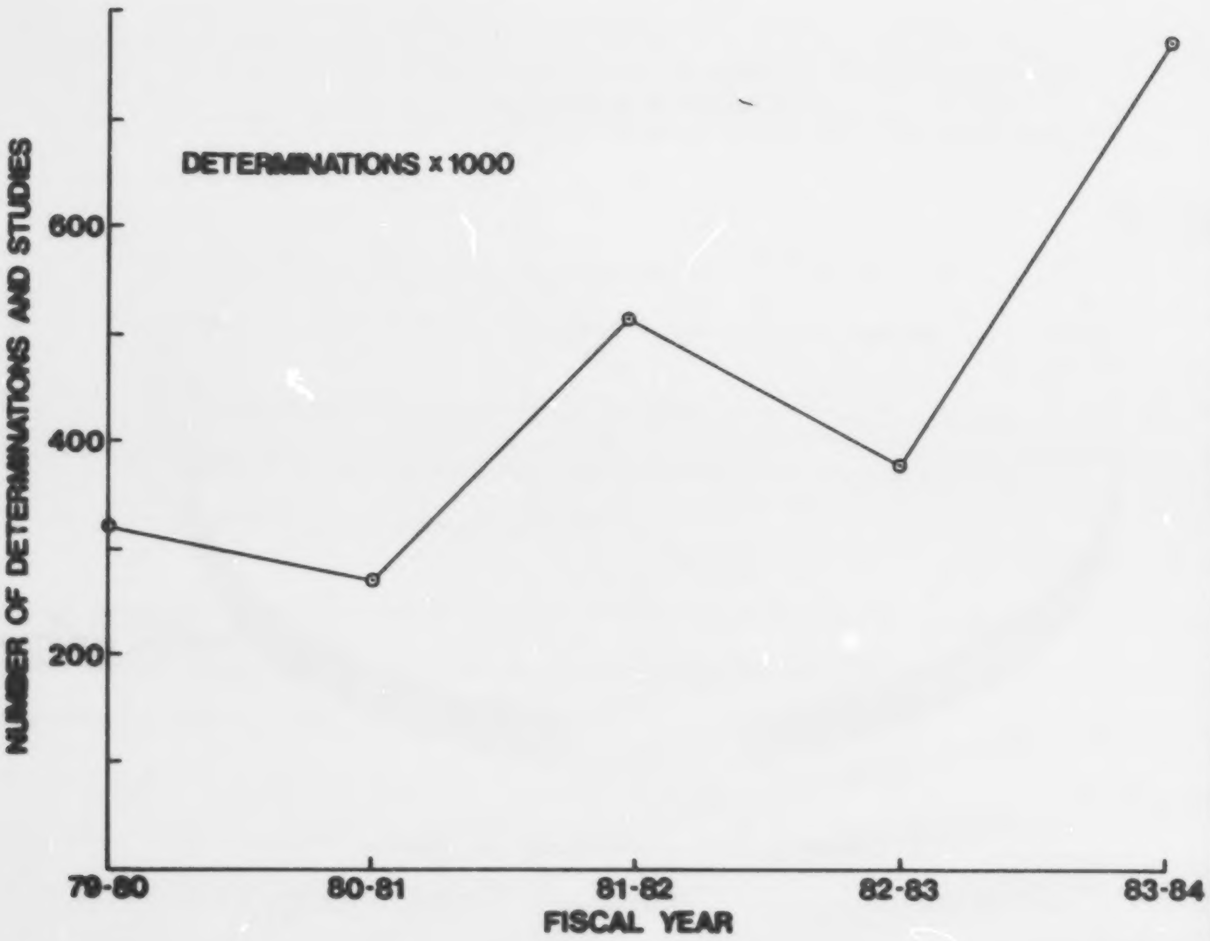


Figure 2. Evolution of A/C production

Analytical work performed by category of customer is shown in Figure 3. Although MER's DGEGM presented us with a considerably larger number of requests this year, the amount of effort devoted to these analyses nonetheless occupied much the same proportion of our resources as last year (65.6%). This is explained by the fact that the R/D section of CRM and the mining companies also increased their demands on our services, although their proportions, compared to last year, remain largely unchanged. Prospectors, public and parapublic organizations presented proportionally fewer demands last year, for the same reasons.

Of the 65.6% of the total effort expended for DGEGM, 32.2% went to Geological Services, 3.3% to alluvial prospecting, and 29.1% to geochemical prospecting. The remaining activities include the CRM R/D section (15.0%), mining companies (11.4%), public and parapublic organizations (3.2%), prospectors (0.5%), and finally, quality control of results within A/C (4.3%).

The analytical results supplied to MER's DGEGM helped to establish a deeper understanding of its extensive knowledge of the territory within Québec's borders, with the aim of identifying potential deposits, and stimulating exploration investment by the mining industry. Some analytical work was undertaken to establish the potentials of certain target areas, making them more attractive to industrial investment, and to verify the correctness of results already obtained, and to understand their significance.

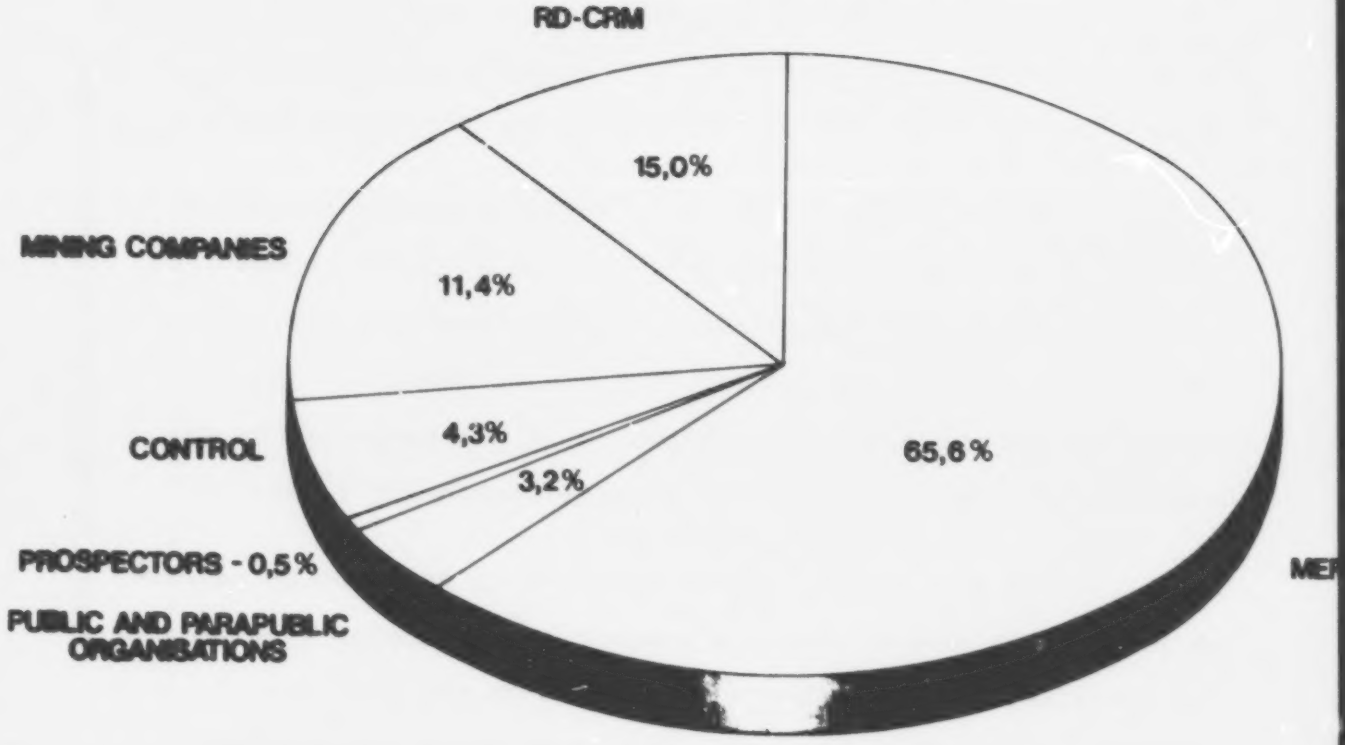


Figure 3. Analysis activity by customer

The A/C laboratories were particularly active with the R/D section of CRM, as they were involved in 106 projects, performing minerological studies and determinations of all kinds, to control, direct, and successfully complete their projects. For example, the study of Crevier ore (project 2011), alone involved 2,094 studies and determinations with a net value of $27,756. Another project (177), on the recovery and purification of used acid for recycling, required 954 determinations at a cost of $11,644. Finally, pilot testwork for the Crevier project (157) involved 6,313 determinations, worth a total of $42,536.

At the elemental level, gold was once again the element that most interested our clientele, either to establish the goldbearing potential of a given region, or simply to verify certain indications. With our capacity far exceeded by demand, samples were ultimately sent to commercial laboratories for such studies. In all, the cost of gold-related analyses and research during the year reached $211,639.

In international cooperation, A/C was invited by The Institute for Geological Sciences (IGS) in London, to participate in the establishment of an analytical standard reference material. The plan involved a sample of copper concentrate, and results were supplied to the program coordinator, Mr. Brian Lyster, in January 1984.

With the emphasis placed on CRM's "get it done" policy, the sum of $682,701 was paid to outside laboratories to undertake mineral analyses. This relatively high figure undoubtedly arose from the fact that the Geochemistry/Geophysics service of DGEGM received a substantial sum ($4 million) in additional budget to carry out geological work; a significant increase in the number of analyses was inevitable. A total of 39,354 samples were analyzed for 367,904 determinations.

Many small contracts (under $5000) were awarded to private companies and to universities.

Some medium-size projects (between $5000-$50,000) were carried out by private laboratories. Two larger analytical contracts were awarded following public tenders. The first involved analysis of hydrogeochemical samples, the second, analysis of geochemical samples. Details relative to each of these contracts may be found in Table 14.

The "get it done" policy enabled us to respond to an unusual number of analytical requests, far exceeding the normal capacity of our laboratory. Despite this, the number of full-time staff fell to a critical level in 1983-84. Further cutbacks would seriously impair the efficiency of our laboratory, and the optimal use of expensive high-performance scientific instruments.

TABLE 14

Analytical Contracts Awarded to Outside Laboratories

COMPANY	NUMBER OF SAMPLES ANALYZED	DETERMINATIONS	COST ($)
Chimitec	23,697	80,853	260,940
Ecole Polytechnique	268	268	3,625
Eco-Recherches	14,000	280,000	385,000
IRNS	99	99	990
Metriclab	100	1,000	1,375
Ontario Research Foundation	1	1	1,000
Sodexen	362	3,620	19,186
Laval University	827	2,063	10,876
TOTAL	39,354	367,904	682,701

ANALYTICAL RESEARCH AND COMPUTER RESEARCH

Research, while only a secondary activity of A/C, continued to play an essential role, particularily in maintaining high standards in analytical services, and to improve internal management through the application of computers.

Considerable efforts were expended in the area of gold. New analytical procedures were introduced, enabling the detection limits for gold and silver to drop into the ppb range, and to increase the analytical precision in low-grade samples. Proven analytical methods will assure the mineral sector of reliable analytical results, upon which will be established the gold-bearing potential of certain regions within Québec.

Installation of a new plasma atomic emission spectrometer was completed in April 1984 and the development of analytical procedures followed throughout May, June and July. With the adoption of atomic emission spectrometry as a routine analytical tool in rock analysis, mineral samples submitted by MER geologists could be analyzed more quickly and easily than ever before, while achieving the same analytical precision.

Anion determination by colorimetry remains useful today even if this long-established technique does not provide the best possible precision. Ion chromatography, recently developed to accurately determine large numbers of anions, remains the technique of choice. Two research projects addressed the latter technique with the aim of expanding our field of application, and to be able to accurately determine anion content in various pregnant solutions from the CRM R/D section.

Elements such as boron and tungsten are among those frequently requested by MER geologists for which there exist no consistent methods for low-level analyses. Methods have been developed in our laboratories to increase the accuracy of analyses for these elements, using optical emission spectrography.

La Société nationale de l'Amiante (SNA) entrusted us with two agreements for the analysis of by-products or compounds formed by its MAGNAQ process. This organization possesses a very good analytical laboratory; however, while well equipped and operated, it is overloaded with day-to-day analyses. It is partly for this reason that they used our services on a regular basis to develop new analytical processes adapted to their scientific instruments.

This situation leads us to believe that efforts should be made in the future to lend assistance to other companies who may be experiencing similar difficulties in improving and developing their analytical procedures, yet who are most likely not as well equipped as the SNA laboratories.

In addition to these internal research projects, two projects carried out under contract by IREM/MERI at Ecole Polytechnique brings the total number of projects to 26, of which the largest are listed in Table 15. The first of these two projects, valued at $20,652, involved efforts to couple a laser to an atomic absorption spectrometer, with the aim of creating an apparatus capable of measuring low levels of gold. This method would be comparable to neutron activation analysis, but at a much lower cost. The second project, valued at $14,630, involved the establishment of a standard reference material containing between 100-150 ppb of gold. Specifically, it will be used as a control in our laboratories, and will be distributed to gold mining companies to assist them in evaluating their techniques for low-level gold determinations.

The computerized analytical data-base system in the A/C section was put into operation at the end of March, 1983. Even if not entirely debugged, it is already proving to be most useful. In fact, we have already discovered that the number of transcription errors inherent in any manual system is now greatly reduced. The system saves time for many A/C staff members who were tied to the manual bookkeeping of the old system. Analytical certificates no longer need to be written out, as the system is able to print them on a letterhead pre-addressed to the customer. The system will soon be expanded to include a system of cross-checking analytical results throughout the A/C section, thereby assuring an independent control for all phases of analysis.

Beyond A/C applications, internal clients are equipped to send their analytical requests directly from their computer terminals. This is especially true of CRM R/D scientists, and of MER geologists. The system also allows a more efficient response to inquiries regarding samples submitted for analysis by external clients.

TABLE 15

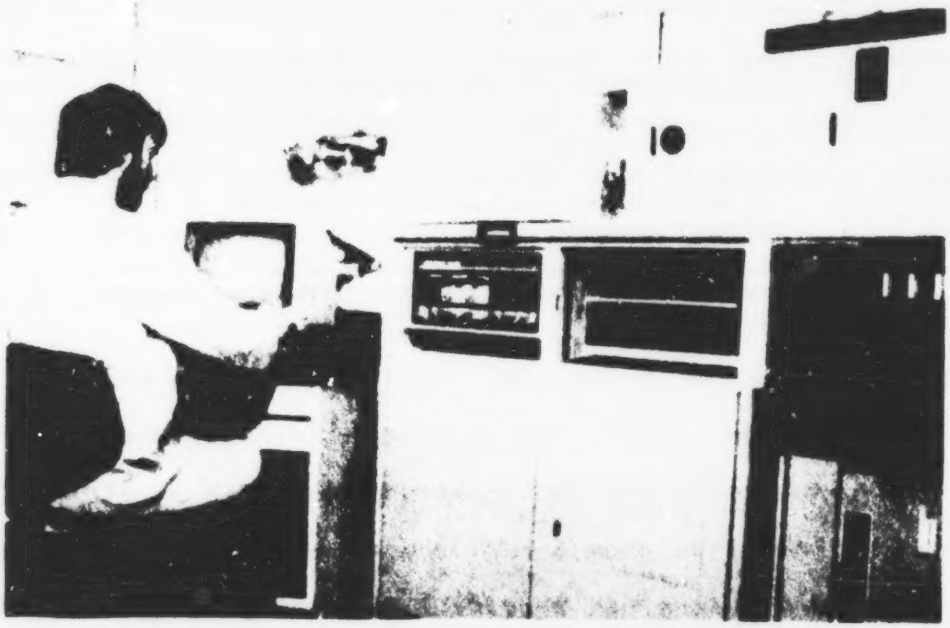
Principal Analytical Research Projects

CUSTOMER	PROJECT	TECHNICAL AUTHORITY
	INTERNAL PROJECTS	
A/C	Detection of ultra-trace gold and silver in rocks, by atomic emission plasma spectrometry, following preconcentration by fire assay.	R. LeHouillier N. Rheaume
A/C	Atomic emission plasma spectrometry applied to the analysis of major and minor elements in rocks.	J. Guimont C. Tremblay G. Vallieres
A/C	Application of ionic chromatography to anion determination.	H. Winter
	FUNDED PROJECTS	
SNA	Analytical procedure for analysis of MgO produced in the MAGNAQ process.	J. Guimont C. Tremblay
SNA	Detection of hydroxide and carbonate in ammoniacal solutions from the MAGNAQ process.	H. Winter

Principal Analytical Research Projects

CUSTOMER	PROJECT	TECHNICAL AUTHORITY
	CONTRACTED PROJECTS*	
A/C	Development of laser-atomic absorption instrumentation for the detection of very small concentrations of gold. ($20,652)	IREM/MERI of Ecole Polytechnique
A/C	Establishment of a reference standard for very small concentrations of gold. ($14,360)	IREM/MERI of Ecole Polytechnique

*Funded by a monetary transfer from the Ministry of Science and Technology.



Simultaneous detection of several elements by plasma atomic emission spectrometry.

TABLE 16

A/C Research Projects and Technical Reports

TITLE	CLIENT COST($)	REPORT AUTHOR(S)	DATE
ANALYTICAL-PROCEDURES PUBLICATIONS			
Procedures to detect trace elements in sediments, rocks, and water.	A/C $13,100	R. Gagne J. Guimont	7/83
Analytical procedures for rocks and ores using atomic absorption spectrometry.	A/C $7,000	R. Brindamour J. Guimont	7/83
Analytical procedures for rocks and ores in solid spectrometry.	A/C $7,600	J. Boivin	2/84
Measure of ^{14}C and ^{3}H (beta radiation) using an LS-8000 liquid scintillation counter.	A/C $350	L. Barrette	1/84
IONIC CHROMATOGRAPHY			
Development and construction of an AFS tubular suppressor for ionic chromatography.	A/C $8,110	H. Winter G. Tremblay	6/83
Modification of operational conditions during analysis of aqueous solutions using ionic chromotography.	A/C $13,150	H. Winter G. Tremblay	12/83
X-RAY DIFFRACTOMETRY			
Survey of CRM professionals on their future needs given the pending installation of highly sophisticated X-ray diffraction equipment.	A/C $3,500	F. Abesque	12/83
Services to be offered to CRM clients by the radio-crystallography division in 1984	A/C $1,050	F. Abesque	11/83

A/C Research Projects and Technical Reports

TITLE	CLIENT COST($)	REPORT AUTHOR(S)	DATE
X-RAY DIFFRACTOMETRY			
Notes on the identification and detection of inorganic crystalline phases by X-ray diffraction.	A/C $2,710	F. Abesque D. Moisan	1/84
INTERNATIONAL REFERENCE STANDARD			
Participation in the certification of an international reference standard from "The Institute of Geological Sciences".	A/C $7,640	N. Zaprianoff	1/84
ELECTROCHEMISTRY			
"Electrochemical determination of some Major and Minor Constituents in Metallurgical and Geological samples"	A/C $15,550	H. Winter G. Tremblay	8/83
TECHNICAL INFORMATION			
Dissemination of scientific and technical information at the 51st annual ACFAS conference.	A/C $4,710	S. Turmel	5/83
COMPUTER SCIENCE			
"Plasma" software	A/C $16,320	L. Barrette	10/83
Installation of a computer network around CRM's IBM-34	A/C $124,900	L. Barrette	1/84
Interfacing an X-ray fluorescence spectrometer to an APPLE II PLUS microcomputer.	A/C $22,850	L. Barrette C. Cote R. Morasse D. Parent *	2/84

* Student in the Mathematics Department of Laval University.

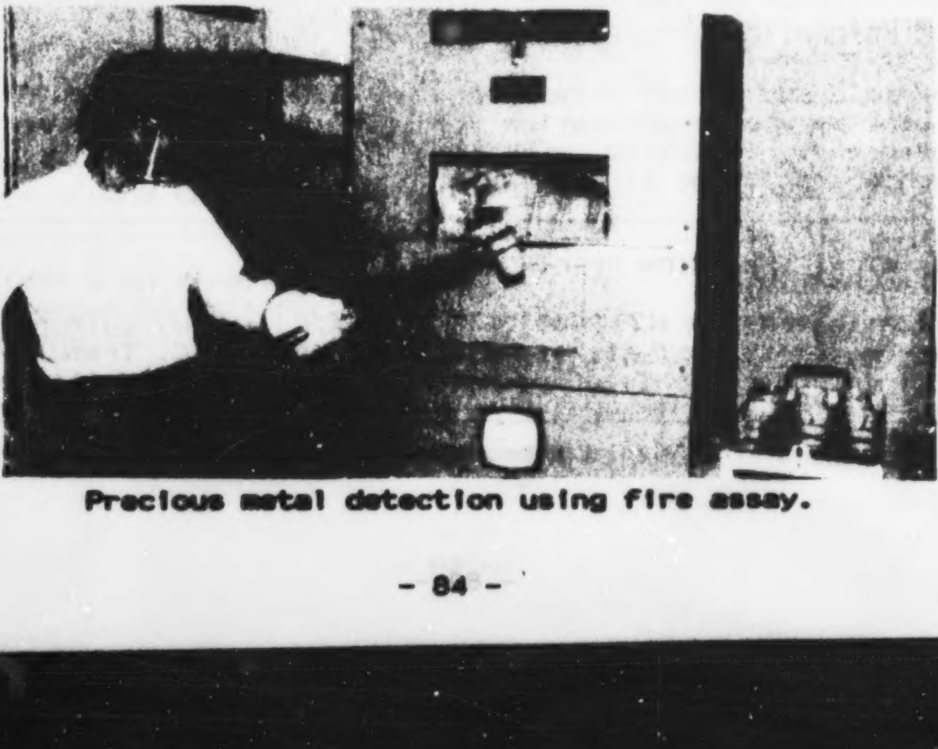
A/C Research Projects and Technical Reports

TITLE	CLIENT COST($)	REPORT AUTHOR(S)	DATE
EXTERNAL PROJECTS			
Establishment of an analytical procedure for MgO analysis in the MAGNAQ process.	SNA $11,050	J. Guimont C. Tremblay	4/83
Detection of hydroxide and carbonate in ammoniac solutions from the MAGNAQ process.	SNA $6,500	H. Winter	4/83
PYROANALYSIS			
Quality and analysis of precious metal beads produced by fire assay.	A/C $33,500	R. LeHouillier N. Rheaume P. Plourde	1/84
OPTICAL EMISSION SPECTROMETRY			
Trace tungsten detection in rocks by optical emission spectrometry.	A/C $34,450	Z. Katzendorfer	4/83
Trace boron detection in rocks: amelioration of a method using optical emission spectrometry.	A/C $32,915	Z. Katzendorfer J. Boivin	1/84
ATOMIC ABSORPTION SPECTROMETRY			
Trace gold and silver detection in rocks by atomic absorption spectrometry, following preconcentration by fire assay.	A/C $40,380	R. LeHouillier N. Rheaume	7/83
PLASMA ATOMIC EMISSION SPECTROMETRY			
Application of the ICP-9000 spectrometer to analysis of major and minor constituents of rocks.	A/C $46,060	J. Guimont C. Tremblay G. Vallieres	7/83

A/C Research Projects and Technical Reports

TITLE	CLIENT COST($)	REPORT AUTHOR(S)	DATE
Use of a secondary cadmium standard in analysis of the major and minor constituents of rocks with the ICP-9000 Spectrometer.	A/C $5,420	C. DeBlois J. Guimont C. Tremblay	12/83
X-RAY SPECTROSCOPY			
Study for the purchase of an automated X-ray spectrometer.	A/C $18,900	S. Turmel	8/83
Application of the alpha-coefficients method to the analysis of different ores and rocks in various matrixes.	A/C $11,600	S. Turmel	12/83
Computerization of data-analysis on standard curves.	A/C $8,950	J. Boivin J. Tremblay	2/84

NOTE: Inclusion in this annual report of internal research projects and technical reports does not imply that these reports are available for general distribution. A list of publications available from CRM is to be published in the fall of 1984; the information necessary to order copies of these documents will also be included.



Precious metal detection using fire assay.

FUTURE PERSPECTIVES

During the coming year, analysis of mineral substances will once again dominate our activities. This service is provided primarily to DGEGM at MER, the R/D section of CRM, and the mining companies.

The "get it done" policy will continue to be stressed in the coming years. Thus, a large number of analyses will be directed towards commercial laboratories, particularily those in the areas of geochemistry, hydrogeochemistry, and some gold determinations. As availability permits, some analytical work will be directed towards university laboratories.

Analytical research constitutes an indispensable development instrument for any group such as ours wishing to advance and stay on the forefronts of technology. Therefore, the relative magnitude of efforts in this area will be maintained much as last year. On the other hand, the process of consolidating our internal research efforts being well-advanced, this activity will , more than ever, be directed towards the mining companies to improve the performance of their laboratories. This will assure the companies of better means of optimizing their processing techniques.

We will continue to be quite active in the development of precise analytical methods for precious metals. The development of analytical methods using ion chromatography will remain an important concern. Many applications are foreseen in this area to solve problems encountered while analyzing samples from the R/D group at CRM.

We plan to demonstrate an analytical procedure with which it will be possible to simultaneously identify close to twenty trace elements in rocks using atomic emission plasma spectrometry. Other methods are to be developed to identify major, minor and trace elements in rocks, using a new automated X-ray spectrometer. These improvements will considerably increase our production capacity, decrease analytical costs, and shorten the analysis time, at a minimum investment in human resources.

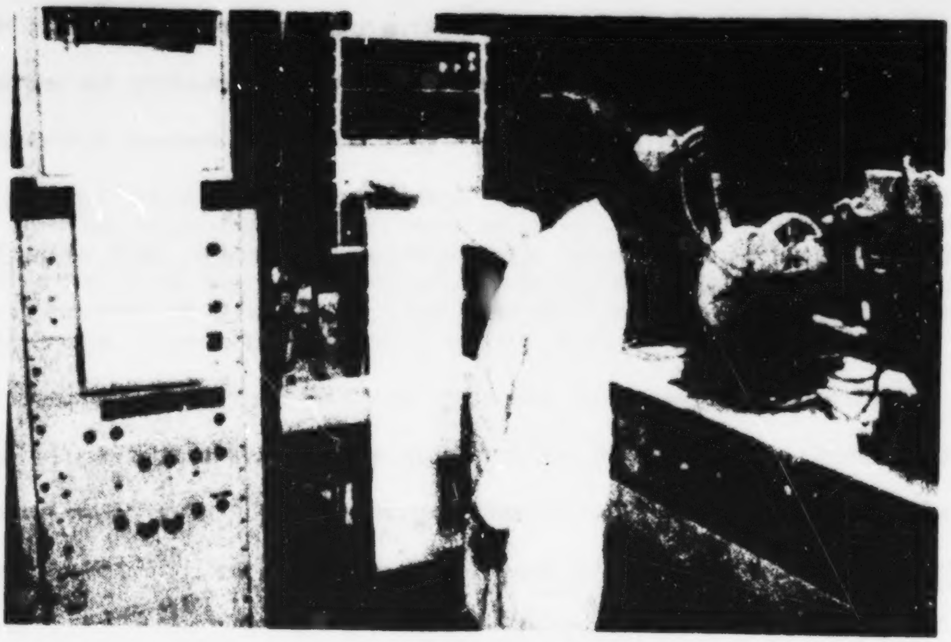
In computer applications, particular emphasis is to be directed to interfacing scientific instruments to microcomputers or to our main IBM-34 computer, for automated acquistion and data processing. The optimization of our analytical data-base system, the development of computer security and finally, the installation of a system to manage the finances and inventory of the CRM stores, constitute the main thrust of our efforts in this area.

The Québec mineral industry is facing stiff challenges from international competitors. To survive, the industry must depend on the development of less-costly and more efficient benificiation techniques, and on the manufacture of high-quality final products. Therefore, the viability of Québec's mining companies are increasingly dependent on the processing techniques which scientists working in the area are able to ameliorate.

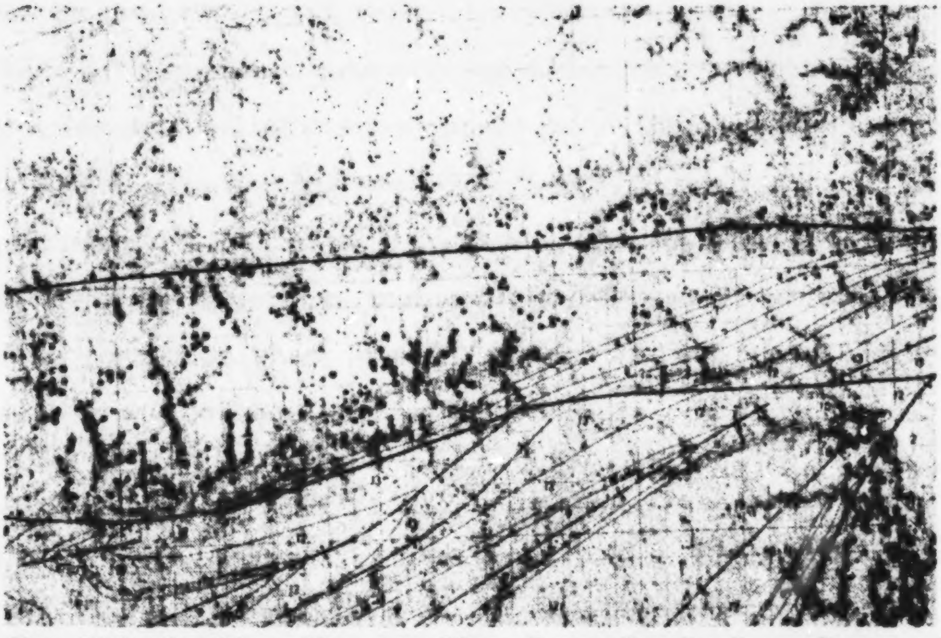
Clearly, it has become of the utmost priority that the scientists in R/D and those within the mining industry be able to count on an effective mineralogical group, established within CRM, capable of supplying precise and in-depth scientific information regarding mineral composition, texture, and structure of ores which are becoming increasingly difficult to process.

We are striving to develop this area in the future, to the benefit of all concerns within the mineral industry, particularly for the mining companies unable to take advantage of specialized mineral analysis equipment because of the high cost of such equipment.

The acquistion of a computerized automated X-ray diffractometer, early in 1985, will mark the first step in this direction. The next stage will involve the purchase of a microwave probe coupled to an image-processing system, in 1986, followed by an automated infrared system in 1987. We will then be much better equipped to supply data to scientists, permitting them to optimize certain operations such as grinding, to make informed decisions pertaining to their processing techniques, and to better evaluate the economic aspects related to their mineral deposits and benificiation techniques.



Mineral analysis using X-ray diffraction spectrometry



Map illustrating the results of geochemical analyses of sediments from streams within the Baie Des Chaleurs. (Original Scale 1:125000 / 1 kilometer)

MINING TECHNOLOGY

Section Head:

Louis-Georges Tanguay

GENERAL OBJECTIVES

The Mining Technology Section (STM) was created in response to needs expressed by representatives of the mineral industry. Its mandate is therefore to undertake research and development in mining technology, as funded by developers and other members of the mining industry. It aims to provide an expertise able to contribute to the optimized profitability of mining endeavours, and to promote the rational exploitation of Québec's mineral deposits.

Given the needs of the mining sector in Québec, the principal objectives which have been formulated are;

- to encourage and stimulate the focussing of efforts by the various groups active in mining technology, such as universities, industries, and researchers.
- to encourage, where possible, the introduction and transfer of knowledge and outside technology into Québec's mining industry.
- to cultivate available expertise in the different areas of mining technology such as ground control, mining equipment, mining methods, and energy conservation.

- to initiate, encourage, and follow up the design, development, and utilization of instruments, equipment, mining techniques, and working methods specifically adapted to the needs and conditions within Québec.

- to analyze and predict the requirements of the mining industry, and to seek solutions to mining problems.

ORGANIZATION/PERSONNEL/EXPENDITURES

The Mining Technology Section is made up of three divisions:

- the Geomechanical Studies division works towards the solution of problems related to rock mechanics and soil mechanics.
- the Engineering and Exploitation division is concerned mainly with problems related to exploitation techniques, the development of mining equipment, and instrumentation.
- the Laboratory and Experimentation division attends to requests for testwork, analyses, and experimentation.

As of March 31, 1984, the personnel of STM consisted of a total of fourteen people, of whom three were part-time. The group comprises six engineers and five technicians (two part-time). Finally, there were three administrative employees, including the section head, and two secretaries (one part-time).

The total budget of the section was $724,800, including operating expenditures and staff salaries.

The STM section benefits from the recommendations of an advisory committee, made up of three representatives of the mineral industry (including the director general of AMMQ), two university representatives, the director general of CRM and the head of STM. This committee met in May and December 1983 and the principal recommendations presented to STM include:

- a study of the development of software to simulate the ventilation networks of underground mines;
- research into the use of computers in our mines;
- a technical service, by an experienced person, covering the inspection and training in the use of mining machinery (skip hoist);
- creation, within STM, of a section for development of mining equipment (one or two people);
- a study of underground blasting methods.

SUMMARY OF ACTIVITIES

The engineers and technicians within the STM section worked on a total of 22 projects during the year, (Table 17). Of this total, 11 were concluded before the end of the 1983-84 fiscal year: 3 externally-funded projects, 1 pilot study, and 7 internal projects. This result is quite acceptable, given the short existence of STM, the size of its staff, and the economic crisis besieging a large number of companies in the mineral sector. Of 22 projects, 6 were funded externally, and some new internal projects, combined with fresh marketing efforts promise to bring us a number of new industrially-funded projects in the near future. Most of the projects undertaken during the year were medium-size (between $5000-$25,000) as shown in Table 18. Small and medium scale businesses within Québec benefited the most from STM's activities, amassing 34% of the projects (Table 19). The government received another 30.5%, large businesses, 10.7%, and customer groups, 20.7%. The total cost of STM projects was $457,400 (Table 20).

During this first year of its existence, despite some startup difficulties, and a hostile economic climate, STM's team of engineers and technicians made several significant accomplishments which will allow some Québec mining companies to improve mining techniques and possibly decrease production costs. Some of these achievements include:

- the development and installation of a computer program allowing advanced processing of inclinometric data using a statistical method;

- the outline of a work program dealing with ground control of inclined-ramp pillars necessary in the reopening of a gold mine;

TABLE 17

Nature of STM Projects

INDUSTRIALLY* -FUNDED		PILOT STUDIES and JOINT PROJECTS		INTERNAL PROJECTS	
NUMBER	HOURS	NUMBER	HOURS	NUMBER	HOURS
6	1971	6	1048	10	4404

* Projects done under contracts from external clients.

TABLE 18

Value of STM Projects

VALUE OF PROJECTS ($)	NUMBER OF PROJECTS
over 50,000	1
25 - 50,000	3
5 - 25,000	9
less than 5000	9

TABLE 19

Division of STM Projects by Customer

TYPE OF CUSTOMER	PERCENTAGE
Government[*1]	30.5
Large companies	10.7
Small companies	34.3
Universities	----
Crown corporations	----
Consultants	3.0
Customer groups[*2]	21.5

[*1] Largely from project 331:
"Technical support to the Industrial Mining Assistance section"

[*2] Internal projects, such as:
"Underground Communications (306)"
"Energy Conservation (307)"
"Rules for the Use of Rock bolts (304)"

TABLE 20

Resources Allocated to Each Project

TYPE OF PROJECT	COST ($)
Government-funded	185,000
Industrially-funded	102,600
Pilot-Studies and Joint Projects	68,800
Internal Projects	98,400
Contracted Projects	2,100
TOTAL	457,400

- the beginning of a study of crown pillars, in mines within the Canadian Shield, to improve engineering and design;

- the study of overburden, crown pillars, and loose in mines.

Twenty-two internal projects were undertaken during the year, of which a few terminated in promising results. It is anticipated, in the near future, that they will lead to funded projects with the aim of satisfying the needs established by the industry. Here are a few examples of these projects:

- field trials, with partial success, of operational underground communication systems destined to serve specific needs. This was part of research towards an integrated communication system;

- inventory of current practices of rock-bolting in certain underground mines, to identify and define rules for rock-bolting;

- participation in programs to evaluate energy costs, and to reduce costs through the use of innovative technology in the development of a heat-pump;

- inventory of the use of lubricating oils and development of a system to recycle used oil;

- visits to various Québec research centers, working in ground control, to identify the needs of the STM section in rock mechanics and the potential for collaboration to the benefit of the industry.

Research contracts were negotiated with university researchers having expertise complementing that of STM staff, to better respond to the needs of the mineral industry. (Table 21) This led to a study of the cause and effect relationships between the production bonus paid to miners and the productivity, profits and safety in underground mines. Another study is under way, for Québec mining companies, on computer needs in mining operations and an evaluation of current use of computers in this area.

Two conferences were organized during this first year of STM activities. The first, on the "Productivity of Open-Pit Mines", held in Québec City in February, brought together about 35 people, including directors and associate directors from ten mining companies, professors from three universities, and five professionals from two research centers. The participants were enlightened on industry needs in the areas of mining equipment, management methods, rock mechanics, and computerization. The second, on "Ground Control in Underground Mine Workings", held in Sainte-Foy in the month of March, brought together about thirty mining engineers, researchers, and university representatives. The marked interest shown at the conference by many of the participants led to a number of lively and profitable

TABLE 21

Research Projects Negotiated with External Organizations*

TITLE	ORGANIZATION	VALUE
Study of the cause and effect relationship between the bonus system and productivity, profits, and safety in underground mining.	Laval University	$40,000
Survey of Québec mining companies on computer needs in mining operations.	Ecole Polytechnique	$20,000

* Ongoing research continues in 1984-85

discussions. Much emphasis was put on the importance of technology transfer to favour operators, in addition to certain work to be done in response to specific needs: means of support, simulation programs, control of roof stability, and engineering of crown pillars.

STM PROJECTS BY AREA OF ACTIVITY

The activities of STM can all be classified into one of four domains:

- Ground Control and Instrumentation

This field includes activities centered around the stability of ground affected directly or indirectly by mining development. This involves the use of conventional geomechanical techniques as well as new technology in monitoring equipment. Methods used include: drilling, core sampling, trials and laboratory testing, field trials, and calculations using numerical modelling.

- Exploitation Methods

This area includes activities aimed at evaluation and optimization in choosing a development method. This work must be done as a function of market forecasts, geological context, geomechanical constraints, and the limitations imposed by the configuration, depth, and reserves of the deposit.

- Industrial Mining Engineering

This area includes activies directed to the optimization through innovation of such operations as drilling and blasting, transportation and extraction, mining equipment, back-filling, ventilation, and underground communications. Methods used include operational research, industrial mining research, and computer methods.

- Energy Conservation

This area includes activities to reduce the energy costs of underground mining operations, the large proportion of which is used to heat both underground workplaces and surface installations. R&D work is also undertaken to stimulate the use of new technologies, for example, high capacity heat pumps. Finally, a study is being carried out on the efficient recycling of used lubricating and hydraulic oils.

In 1983-84 the technical personnel at STM devoted 7,432 hours to the completion of projects, or 53.5% of the available time. (Table 22, 23) These project activities can be divided into 42.9% for activities outside of the Ministry of Energy and Resources, and 57.1% for internal activities.

Ground control and instrumentation have occupied much of the efforts of STM in 1983-84, with 57.6% of the total time. This area involves, almost exclusively, laboratory tests and

TABLE 22

STM Activities

Number of Hours Available (Eng. & Tech.)	13860
Number of Hours Worked on Project Activities	7432
Proportion of Hours Worked (Project Activities) over the Number of Available Hours	53.5%
Distribution of Hours Worked by Activity (%)	
External Activities	42.9
Funded Projects	21.2
Pilot Projects and Joint Projects	11.2
Client Visits and Preparation of Work Plans	8.6
Mine Visits, Symposiums, Conferences	1.9
Internal Activities	57.1
Internal and Special Projects	47.1
General Research and Documentation	10.0
Distribution of Hours Worked on Projects by Area of Activity (%)	
Ground Control and Instrumentation	57.6
Exploitation Methods	12.1
Industrial Mining Engineering	18.7
Energy Conservation	11.6

TABLE 23

STM Research Projects

TITLE (Project Number)	CLIENT	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
	FUNDED PROJECTS		
Stability of backfill. (301)	LES MINES BELMORAL LTEE	615 $36,456	G. Duchesne
Recovery of ore from the west end.(302)	LES MINES BELMORAL LTEE	197 $11,685	G. Duchesne
Geotechnical study of overburden.(303)	LES MINES BELMORAL LTEE	212 $18,500	J.D. Allard
Engineering of crown pillars.(310)	ROCHE MINES ASSOCIES LTEE	124 $6,511	J.M. Robert
Analysis of inclinometric data.(327)	J.M. ASBESTOS INC.	615 $20,467	J.D. Allard
Pillar stability in inclined ramps.	LES MINES GOLDSEARCH LTEE	208 $8,958	P. Rochon
	INTERNAL PROJECTS		
Rules for rock bolt use. (304)	------	218 $12,685	J.M. Robert
Construction of charts for evaluating the stability of talus.(305)	------	23 $1,072	J.M. Robert
Underground communications. (306)	------	848 $40,055	R. Masse
Recovery and planning of Energy uses.	------	691 $31,015	J.P.DesRosiers J.G.Dionne

STM Research Projects

TITLE (Project Number)	RESOURCES (hrs, $)	TECHNICAL AUTHORITY
INTERNAL PROJECTS		
Acquistion of scientific instruments and equipment. (309)	177 $7,177	J.P. DesRosiers
Inventory of rock mechanics analysis techniques and equipment. (313)	7 $99	J.P. DesRosiers
Installation of the "BOUDEM" software. (314)	11 $437	J.P. DesRosiers
Training period at CANMET research lab. (315)	203 $11,264	J.P. DesRosiers
Evaluation of optimal operating methods at the Ferderber mine. (329)	18 $60	G. Duchesne
Technical support to SAIM. (331)	2876 $76,882	J.P. DesRosiers
Installation of CANMET software. (332)	15 $577	J.P. DesRosiers
Rock anchoring device. (335)	9 $247	J.M. Robert
Survey on computer needs in mining operations. (336)	34 $1,499	P. Rochon
Recycling of used oils. (340)	82 $2,993	J.P. DesRosiers J.G. Dionne
Sulpherous mine dumps: Phase I. (344)	30 $1,468	J.G. Dionne
Underground Communications: Phase II. (348)	210 $9,097	J.P. DesRosiers

Projects and pilot-projects 305, 313, 314, 329, 332, and 335 were inactive at the end of the year, either because of other priorities, or because of delays in the acceptance of proposals.

on-site testing. It also includes work on a soil mechanics project necessary to complete the work of the old Geotechnical Service at MER and to prepare maps illustrating the dangers of natural ground movements. This project should be completed before the end of 1984. Work was carried out on a total of 13 research projects, 4 of which were completed during the year.

The three other areas of interest of STM competed for 42.4% of the available time. Mining methods included only one major project, and accounted for 12.1% of working time; that project will continue into 1984-85. Industrial mining engineering expended 18.7% of available time, including an extensive project on underground communications, and the new technical services contracted on extraction machinery in underground mining. Techniques in energy conservation consumed 11.7% of STM's efforts.

The division of STM resources by admistrative region is not uniform (Table 24). This unbalance is explained by the large number of internal projects underway during 1983-84 which all the regions should benefit from. The region of Abitibi-Témiscamingue, where large-scale mining operations are fuelled by gold and its high value, was particularly favourable to the work of STM.

FUTURE PERSPECTIVES

Still in its infancy, the STM section plans to improve its services and activities in the area of mining technology during the coming year.

TABLE 24

Division of STM Resources by Region

REGION	RESOURCES (percentage)
01 Bas St-Laurent-Gaspesie	-
02 Saguenay-Lac St-Jean	-
03 Québec	0.2
04 Trois-Rivieres	0.3
05 Estrie	6.9
06 Montreal	-
07 Outaouais	-
08 Abitibi-Témiscamingue	25.9
09 Cote-Nord	-
10 Nouveau-Québec	-
Total	66.7

In the coming year, considerable effort will be directed to encouraging and maintaining closer ties between STM and the mining industry, so that a large number of projects can be oriented towards its most serious problems. Steps towards meeting this objective will include a number of visits and meetings with producers, project proposals in these priority areas, and the undertaking of a number of pilot studies structured so as to satisfy identified needs.

The STM section plans to increase its involvement in the following four areas: ground control and instrumentation, mining methods, industrial mining engineering, and energy conservation. To this end, four priorities have been established for the coming year:

- development of expertise in rock mechanics and the installation of new laboratory and field equipment;

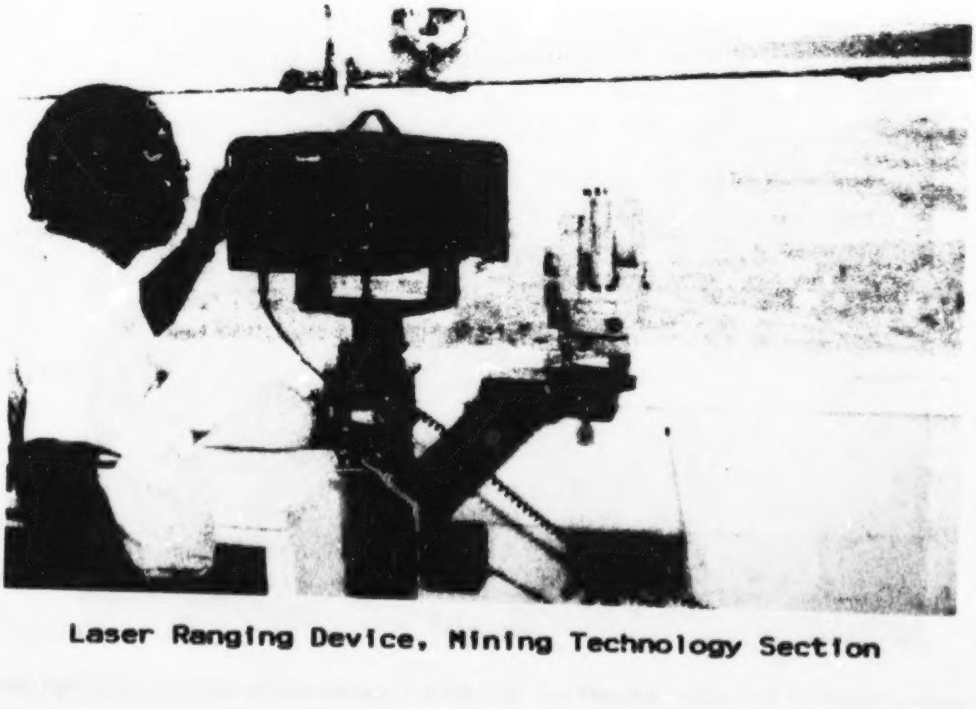
- increased number of projects associated with the development of computerization through the use of available software;

- organization of research projects directed to technological innovation in mining equipment;

- increased efforts in the area of energy conservation in order to better satisfy industry needs and to maximize the economic potential of this area, particularlly in the development of an industrial heat pump and through recycling of used oil.

Every effort will be made to acquire and develop expertise in the above areas. Hiring of competent and qualified part-time staff will be given precedence.

Finally, the STM section will increasingly encourage, within budgetary constraints, studies entrusted to outstanding university groups with experience and expertise in the area of mining exploitation technology, thus encouraging the coordination of research resources to the benefit of Québec's mining industry.



Laser Ranging Device, Mining Technology Section

ALLARD, J.D.

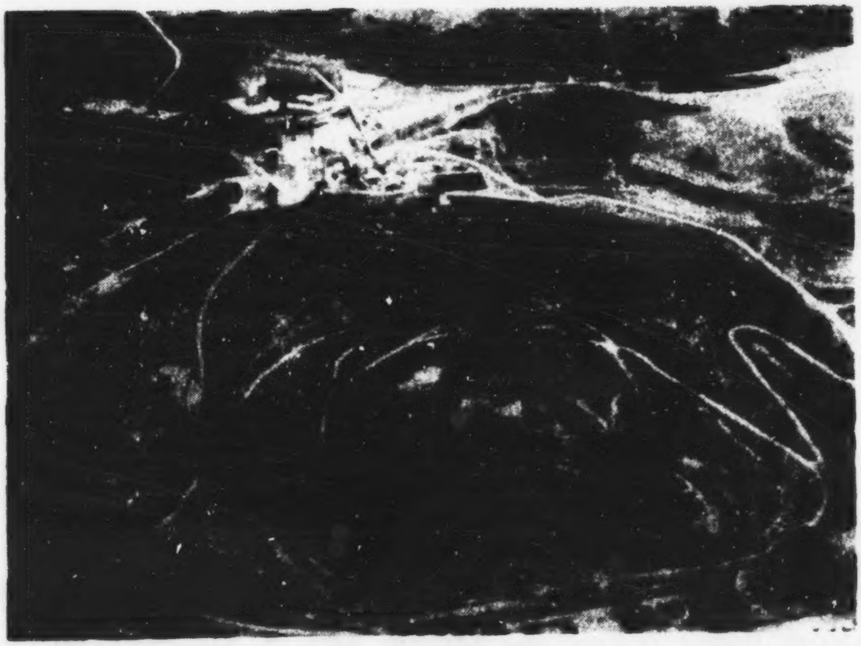
Analyzing Inclinometric Measurements
Final report, Project 327
November 1983

DESROSIERS, J.P.

Proposals for Purchase of
Field and Laboratory Equipment for STM
Final internal report, Project 309
September 1983

ROCHON, P.

Pillar Stability in Inclined Shafts
Final Report, Project 338
December 1983



Slope-stability was studied at this open-pit asbestos mine.

MARKETING AND CONTROL

Section Head:

Albert Allard

GENERAL OBJECTIVES

As its title suggests, the Marketing and Control section (SCC)(Service de Commercialisation et Controle) fulfils two well-defined objectives. First, it must present the services offered by CRM in such a way that mining companies spontaneously seek CRM assistance. This action corresponds to the ministry's drive towards encouraging and assisting in the success of the mineral industry, convinced as it is that research and development is a tried and true course to increased company viability. The second objective is to supply administrative services to all of CRM, in the areas of financial management, purchasing, scientific documentation, and secretarial services.

ADMINISTRATIVE STRUCTURE

The personnel in the section, while few in number, make up a multidisciplinary team able to respond to the different needs of all of CRM. Fifteen employees share various tasks within four divisions: accounting and purchasing, secretarial services, scientific documention, and marketing.

REVIEW OF ACTIVITIES

Marketing and Control activities center, for the most part, around the administration of CRM. Management accounting, and purchasing, for example, are continued year-long activities. In the same way, monthly control of projects in the R/D section and the Mining Technology section, given the time and money involved, demands a good deal of effort.

In addition to these activities, which could be classed as routine or repetitive, the SCC section has contributed to the completion of specific projects for the benefit of all of CRM. Of these, the following few examples illustrate the contribution of the section to CRM's activity:

- given the difficult economic conditions which plague the iron ore industry, an analysis of the current and future contributions of CRM in research activities to this area was undertaken, for the benefit of the committee studying the problem and other parties involved;

- special studies involving certain minerals such as lithium and vanadium were undertaken in order to orient CRM research projects in these areas;

- with the aim of orienting the research organizations to which CRM could possibly award specific research projects, a publication was prepared entitled "A Guide for the Submission of Research Projects to be Financed by CRM.";

- CRM lends great importance to all the projects it undertakes, and to assure that each one receives the attention it deserves, a publication was prepared and distributed to all CRM researchers, entitled "Administrative Procedures for the Management of Research Projects";

- with the participation of other ministries within the Complexe Scientifique, an "Open House" was held in November 1983, inviting the public to visit CRM laboratories. The aim of this event was to allow the general public to see the extent of the technical installations at the Centre and, at the same time, to meet the scientists who work there. The event was an enormous success;

- in its supporting role to other administrative groups, the SCC section participated in the preparation of various documents, such as the 1982-83 Annual Report, the 1984-85 Operating Budget, and the report on computerization and inventory management;

- during 1983-84 particular emphasis was put on the marketing of CRM services. With the arrival of a marketing agent in June 1983, a special effort was made to establish close and lasting bonds with the mining industry. Since that date, over sixty on-site visits have been made to the companies. Meetings with the management of these companies contributed to establishing mutual understanding with the industry;

- the development of a prelimiary marketing plan proceeded, upon which an in-depth study will be based into the needs and requirements of the mining companies;

- an agreement was formalized with the University of Québec at Chicoutimi for the completion of a study into the need for and availability of mineral research and development within the wide-reaching region of Saguenay-Lac St.Jean-Chibougamou-Chapais;

- a similar agreement was forged with the "Eastern Québec Peat-Industry Research Bureau" (BRITEQ)(Bureau de Recherche sur l'Industrie de la Tourbe dans l'Est du Québec) who are to undertake a study into mineral research needs in the Gaspé peninsula east of La Pocatière;

- with the arrival in Québec of the 23rd Annual Metallurgist's Conference, in August 1984, CRM's marketing agent has been appointed to play a key role in the organization of this international event, as president of Public Relations.

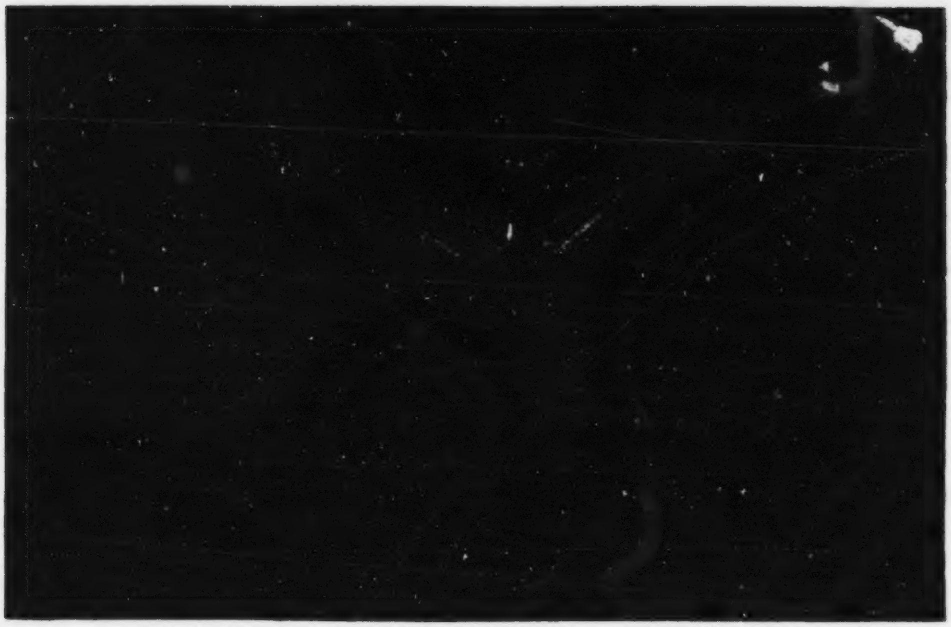
CRM EXPENDITURES

Table 25 compares CRM expenditures over the last three years. It is apparent that expenditures have grown sharply, with annual increases of 12.3% and 66.7% respectively in each of the two years since 1981-82. The main reasons behind the enormous increases in 1983-84 are the establishment of the Mining Technology section late in 1982, with relavent credits appearing for the first time in the 1983-84 budget, the continued renovation work at the pilot plant, and finally, a considerably increased grant to the Asbestos Research and Development Institute (IRDA)(Institut de Recherche et Developpement sur l'Amiante)

FUTURE PERSPECTIVES

The Marketing and Control section will continue its efforts to publicize the services CRM offers to the mining industry. Every effort will be made to convince members of the mining industry that research is an absolutely indispensable activity if the industry is to remain profitable in the face of international competition. Furthermore, with its specialized research staff and advanced equipment, CRM is a vital resource within reach of every corner of the industry.

The section will continue to perfect its methods of internal management, particularly with the installation of a computerized system to control purchasing and expenditures.



Information kiosk publicizing CRN services.

TABLE 25

CRM Expenditures

CATEGORIES and SUB-CATEGORIES	$'000		
	1981-82	1982-83	1983-84
Operations			
1. Salaries	3,478.3	3,533.9	4,300.0
2. Other Wages	171.7	142.0	174.6
3. Communications	19.3	41.3	64.6
4. Services	163.4	133.8	222.0
5. Maintenance	24.6	33.0	46.5
6. Rent	0.2	1.5	6.8
7. Supplies	428.1	411.1	533.2
11. Other	15.7	32.5	23.9
TOTAL	4,301.3	4,329.1	5,371.6
Capital			
8. Equipment	216.3	266.5	579.9
9. Buildings	---	563.6	1,256.4
TOTAL	216.3	830.1	1,836.3
Transfers			
10. Grants (IRDA: $1,000)	537.0	518.0	1,220.1
TOTAL	5,054.6	5,677.2	8,428.0

CONFERENCES PRESENTATIONS BY CRM STAFF

CLAVEAU, A. and
POUSKOWLELI,G. (CANMET)

"The significance of problems in the gold industry with respect to CRM and CANMET planning for 1984-85".
Seminar on gold ore processing,
Val d'Or, March 15-16, 1984.

DELISLE, G.

"Are we getting the maximum potential from our gold ores?"
Seminar on gold ore processing
Val d'Or, March 15-16, 1984.

EVERELL, M.D.

Expose of CRM.
Laval University
February 23, 1984.

EVERELL, M.D.

"Mining productivity and CRM"
Augustin-Frigon Congress,
Ecole Polytechnique
March 8-9, 1984

EVERELL, M.D.

The price of gold and its influence on ore processing technology.
Seminar on gold ore processing.
Val d'Or, March 15-16, 1984

GABRA, G.

"A genetic study of the leaching of gold from pyrite concentrate using acidified thiourea."
113th Annual Meeting of the AIME
Los Angeles, February 1984.

KATZENDORFER, Z.

"Tungsten detection in rocks using optical emission spectroscopy"
51st Annual ACFAS Congress
Trois-Rivieres, May 1983

KOUGIOUMOUTZAKIS, D.

"Peat as a metallic ion-exchanger for processing industrial effluents."
51st Annual ACFAS Congress
Trois-Rivieres, May 1983

KOUGIOUMOUTZAKIS, D.
and MAHEU, J.

"Processing of low-grade ores and residues by heap-leaching."
Seminar on gold ore processing.
Val d'Or, March 15-16, 1984

LEHOUILLIER, R.

"Do undergraduate studies meet the needs of the industry?"
Seminar of the Mining and Metallurgy Department,
Laval University,
February 1984.

LEHOUILLIER, R.

"Problems associated with precious metal detection using fire assay."
Seminar on gold ore processing.
Val d'Or, March 15-16, 1984

PRESENTATIONS AT CONFERENCES AND SYMPOSIUMS BY CRM STAFF

NAGAMORI, M.

"Is our gold precipitate's
fusion process adequate?"
Seminar on gold ore processing.
Val d'Or, March 15-16, 1984

TREMBLAY, R.

"Laboratory and Pilot Plant
testing for flowsheet design."
Short Course on Mineral
Processing of Gold Ores,
McGill University, October 1983.

TREMBLAY, R.

"Use of peat as a binding
agent in pelletizing iron-ore
concentrates"
CANMET Symposium, Ottawa
February 21, 1984.

WINTER , H.

"Electrochemical Determination
of some Major and Minor
constituents in Metallurgical
and Geological samples."
15th Annual Congress of
Canadian Mineral Analysts.
Kamloops, B.C., September, 1983

INTERNAL SEMINARS BY CRM STAFF

BARRETTE, L.

"Operation of the new
analytical data-base system."
March 1984

GUIMONT, J.

"Analysis of rocks using plasma
atomic emission spectrometry"
November 1983

LEHOUILLER, R.

"Quality and composition of
precious metal beads produced
by fire assay."
January 1984

REMILLARD, M. and VACHON, R.

"Grindability index and
simulation of grinding."
April 22, 1984

REMILLARD, M. and VACHON, R.

"The SPOC software, and the
KARRA algorithm."
November 17, 1983

THERIEN, M., LAPLANTE, G. (McGILL)

"Column Flotation"
December 15, 1983

TURMEL, S.

"Potential uses of X-ray
Diffractometry."
November 1983

PUBLICATIONS BY CRM STAFF

BRINDAMOUR, R. and GUIMONT, J.

"Analysis procedures for rocks and ores by atomic absorption spectrometry."
AC-8, MER 1982-83

GABRA, G.

"Studies on the Preparation of pure Niobium Oxide from Pyrochlore concentrate."
METALL, Vol 37, No. 2
February 1983

GAGNE, R. and GUIMONT, J.

"Methods of detecting trace elements in sediments, rocks, and water."
AC-9, MER 1982-83

NAGAMORI, M., JACINTTE, N.
SINKER, S.N. and JOHN, N.Y.

"An Equilibrium Study of the hydrogen reduction of copper sulfates."
Metallurgical Transaction B.
Vol 14B, March 1983

CRM STAFF ACTIVITIES

Québec Metal Mines Association Inc.	
Association des Mines de Metaux de Québec Inc.	
Session Chairman, 1983 Annual meeting	M.D. Everell
Québec Asbestos Producers Association	
Association des Producteurs d'Amiante du Québec	
Member of the technical committee.	G. Foy
Canadian Accreditation Bureau of the	
Canadian Council of Engineers.	
Vice-president, Evaluation Committee of Ecole Polytechnique, Montreal.	M.D. Everell
CANMET	
National Advisory Committee on	
Mining and Metallurgical Research (NACMMR)	
Principal Committee	M.D. Everell
Sub-committee: Mineral Processing	A. Claveau
Sub-committee: Mining Technology	M.D. Everell
Canadian Center for Asbestos Information	
Administrative Council	
Substitute member, representing MER	M.D. Everell
Colloque Augustin-Frigon	
Steelmaking	A. Claveau
ICM 23rd Conference of Metallurgists	
Québec City, August 1984.	
Conference Co-chairman	A.J. Plumpton
Head of Public Relations	S.S. Nosseir
Ecole Polytechnique	
Member of the Committee evaluating the Mining Engineering program.	M.D. Everell
First Québec Conference on Engineering Education	
Ecole Polytechnique, May 1983	
Session President	M.D. Everell

GOVERNMENT OF QUEBEC

Québec Standardization Committee (BNQ)	
Committee member	R. Gagné
Committee on the establishment of employee levels	
Committee member	G. Gabra
Committee member	M. Pichette
Central Supplier Registry	
Committee member	G.H. Cloutier
Committee member	M. Pichette
Ministry of Energy and Resources	
Member of the Committee on Mining	M.D. Everell
Ministry of Energy and Resources	
Advisory Committee on Mining Technology	
Committee member	M.D. Everell
Committee member	L.G. Tanguay
CRM Advisory Committee	
Committee member	M.D. Everell
Committee member	A. Claveau
Committee secretary	G. Castonguay
Mini-Conference on Northern Development Sept-Isles, March 1983	
Session Chairman (economic division)	M.D. Everell
Québec Office of Planning and Development Study group on the future of Schefferville	
MER Representative	M.D. Everell
Québec Public Service Recruitment and Selection Office	
Member of Selection committee	M. Pichette
Round-Table Discussions on Iron (Table de concertation sur le fer)	
Member of the Technical Committee on Productivity	M.D. Everell
Chairman of the Technical Committee on R/D	A. Claveau
Member of the Technical Committee on energy	A. Claveau

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	Director, district No.2	G. Foy
Asbestos Research and Development Institute (IRDA)		
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Québec Order of Chemists		
	Member of the Training Committee	G. Gabra
Québec Order of Technologists in Applied Science		
	Director of the Administrative Council and Recruitment Committee Coordinator	A. Tremblay
	Planning Committee member	Y. St-Louis
International Standards Organization (ISO)		
	Committee member ISO/TC-102	R. LeHouillier
	Committee member ISO/TC-101-103 and 105	I. Malinksy
Roche-Mines Crown Pillar Research Project		
	Orientation Committee	M.D. Everell
Canadian Geotechnical Society		
	Secretary, Eastern Québec Section	J.M. Robert
Québec Explosive-Energy User's Society (SEEQ)		
	Director	L.G. Tanguay

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Teaching Fellow, Steelmaking	R. LeHouillier
Teaching Fellow, Asbestos Technology	G. Foy
Master's Thesis Correction (Jean-José Grand)	M.D. Everell
Member, Engineering Physics Committee	R. LeHouillier
Member, Metallurgy Program Committee (1981-3)	R. LeHouillier
Member, Mining Engineering Program Committee (October 30, 1985)	M.D. Everell

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1983-84 ANNUAL REPORT

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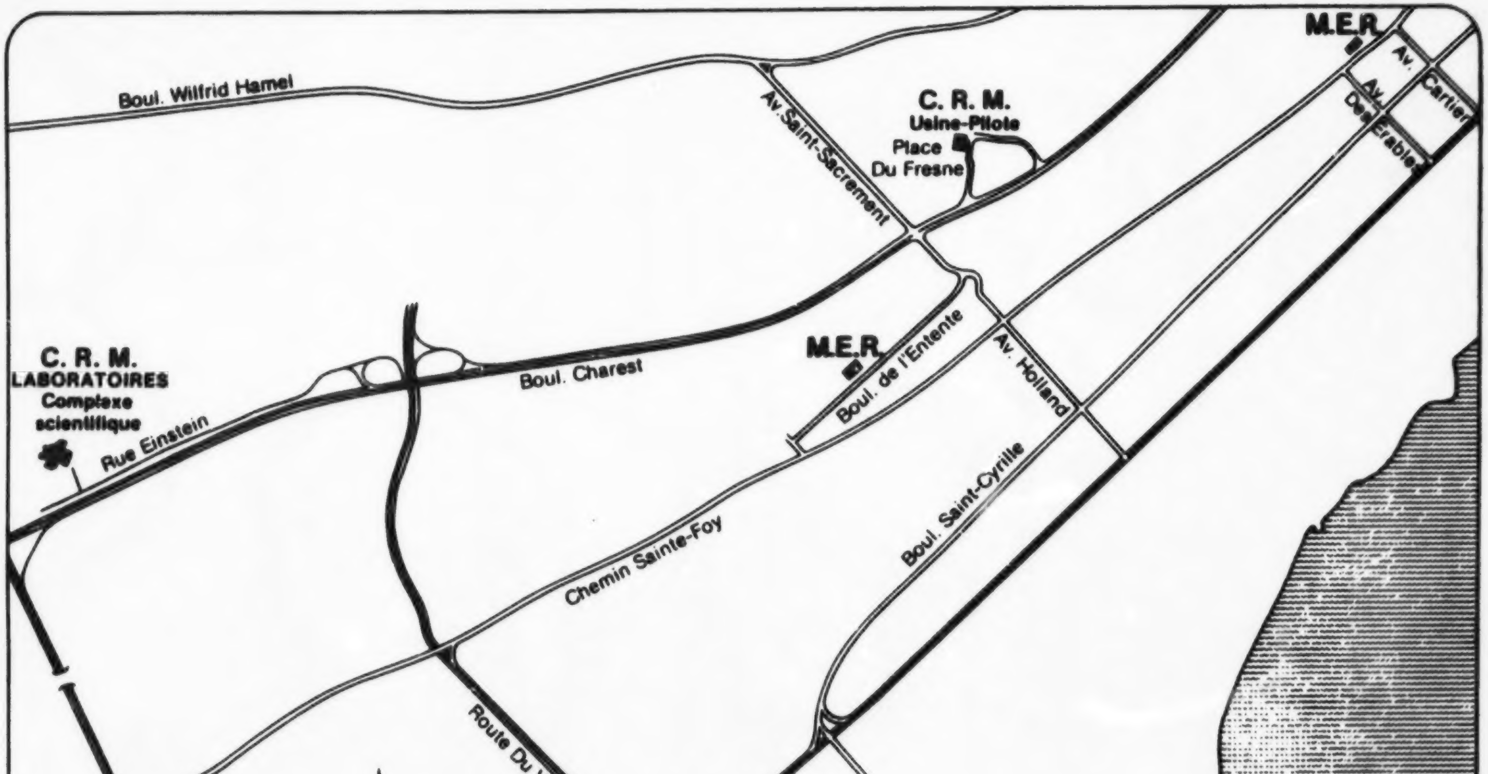
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